TTI 1200

PHASE JITTER TEST SET

INSTRUCTION MANUAL

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TTI 1200
PHASE JITTER TEST SET

TELECOMMUNICATIONS TECHNOLOGY, INC.
555 DEL REY, SUNNYVALE, CALIFORNIA

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TABLE OF CONTENTS

SECTION	CONTENTS	PAGE
1.	GENERAL	1
	UNPACKING	1
	INSTALLATION	1
2.	OPERATING CONTROLS, INDICATORS, AND JACKS	1
	FRONT PANEL	1
	REAR PANEL	3
3.	OPERATION	3
	CONNECTING THE TEST SET	3
	PHASE JITTER TESTS	4
4.	SPECIFICATIONS	4
5.	MAINTENANCE AND CALIBRATION	5
	MAINTENANCE	5
	REQUIRED TEST EQUIPMENT	5
	DISASSEMBLY	5
	REASSEMBLY	7
	CALIBRATION PROCEDURES	7
	Power Supply, Circuit Board #3—Calibration	7
	Circuit Board #1—Calibration	7
	Circuit Board #2—Calibration	8
	Miscellaneous Tests	11
6.	PRINCIPALS OF OPERATION	11
7.	FACTORY REPAIR SERVICE	16
	MALFUNCTION REPORT	16
	SHIPPING INSTRUCTIONS	16
	CHARGES	16
8.	PARTS LISTS	18 thru 37
9.	SCHEMATIC DRAWINGS	38 thru 41

1. GENERAL

1.01 This document contains information on operation and maintenance of the TTI 1200 Phase Jitter Test Set. Included are schematic diagrams, a parts list, and descriptions of TTI's warranty and factory repair service.

1.02 The TTI 1200 Phase Jitter Test Set measures phase jitter at the voice-frequency points on transmission facilities. The instrument receives a test tone from the far end and provides a digital display of the phase jitter on the test tone. The measurement range is from 00.0 degrees to 99.9 degrees (an overrange indicator is included). The Test Set automatically phase locks to the test tone frequency. No manual adjustments are necessary for either level or phase lock.

1.03 The Test Set incorporates three operating modes. One mode meets the industry standard for phase jitter measurements. The other two modes provide additional measurement analysis capability to aid in defining an apparent jitter problem and identifying the source.

UNPACKING

1.04 Since the Test Set is shipped fully assembled, in a single shipping container, no special unpacking procedure is required. It is preferable to open the container from the end bearing the placard "Open this end." This will allow immediate access to the handle.

INSTALLATION

1.05 Installation consists of two steps:

a. Set the rear panel power switch (see Paragraph 2.02) for 115 Vac or 230 Vac operation before connecting the power cable.

b. Connect the power cable to a 115 Vac or a 230 Vac single-phase power outlet.

2. OPERATING CONTROLS, INDICATORS, AND JACKS

FRONT PANEL

2.01 The following operating controls, indicators, and jacks appear on the front panel of the Phase Jitter Test Set. They are listed here from left to right and from top to bottom. (Refer to Figure 2-1.)

a. POWER. This is a push-button switch that turns the instrument on and off. An indicator light, located above the switch, is illuminated when the power is on.

b. DIGITAL DISPLAY. Three Nixie* tubes in the digital display provide a direct readout of phase jitter to a resolution of 0.1 degree. The display is automatically blanked when the incoming test tone signal is outside the proper level range (—40 to +10 dBm) or when the instrument is not phase locked to the incoming signal. The display is also blanked under certain conditions in the P-P FLT IN operating mode (see "c" below). A decimal point on the left side of the display acts as an overrange indicator. This decimal point lights whenever the display reading exceeds 99.9 degrees.

c. MODE. This three-position switch selects any one of three operating modes. The operation in these modes is as follows:
P-P FLT IN. This mode meets the provisions of the accepted industry standard for phase jitter measurements, as defined in Bell System Technical Reference PUB 41009. In this mode, the instrument requires a test tone frequency of 1020 Hz ±40 Hz. If the frequency is outside this range, the display is automatically blanked. For the engineer interested in the details of the instrument, it should be pointed out that the input filtering of the instrument in this mode passes only those frequency components between 300 Hz and 1800 Hz. Post phase-detection filtering further restricts the measurement to jitter components that are more than 20 Hz and less than 300 Hz from the test tone frequency.**The display indicates the peak-to-peak value of the detected phase jitter.
P-P FLT OUT. This mode also measures peak-to-peak phase jitter, but the input and output lowpass filters are removed. The Test Set accepts and measures the phase jitter on any test tone from 500 Hz to 3 kHz. The display then indicates the total phase excursion of the received test tone, including true phase jitter effects and the effects of "quasi-phase jitter" that may be caused by extraneous signals and noise on the test circuit.

*Trademark of the Burroughs Corporation

**Since phase jitter is the result of angle modulation, the Test Set effectively measures the sidebands produced by an unwanted modulating frequency from 20 to 300 Hz.

Figure 2-1. TTI 1200 Phase Jitter Test Set, Front View.

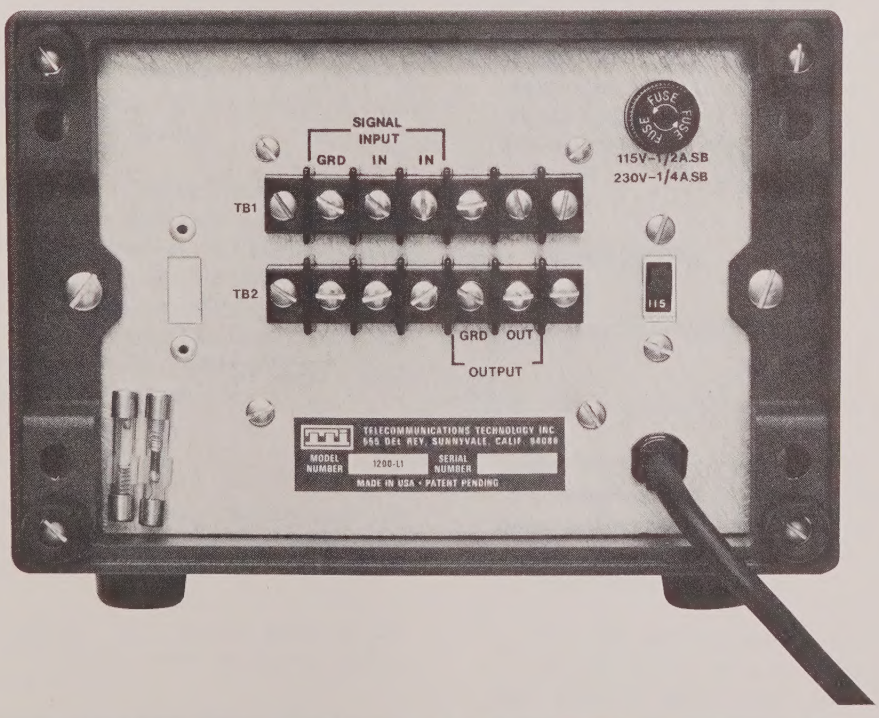


Figure 2-2. TTI 1200 Phase Jitter Test Set, Rear View.

PEAK/CYCLE. In this switch position, the Test Set provides readings of peak per-cycle phase jitter.* This measurement mode is particularly sensitive to high-frequency jitter components (such high-frequency components are de-emphasized by the peak-to-peak total jitter measurement). In the PEAK/CYCLE mode, the Test Set accepts any test tone frequency from 500 Hz to 3 kHz. As in the P-P FLT OUT mode, the display indicates both true and quasi jitter components up to the test tone frequency.

d. IMPEDANCE. Two push-button switches provide for the selection of either 600-ohm or 900-ohm input impedance. The selection of input impedance simply ensures that the Test Set presents the proper impedance to the test circuit. Impedance selection is not normally critical unless the level of the test tone is near the extremes of the Test Set's range.

e. DAMPING. Two push-button switches select the degree of damping in the reading shown on the display. When the instrument is set for LO damping, the display indicates the phase jitter averaged over a period of 0.1 second. When HI damping is selected, the display indicates the phase jitter averaged over a period of 1.0 second. HI damping is recommended only when jitter readings fluctuate widely and rapidly.

f. INPUT. This jack accepts a 310 plug to provide the incoming test tone from the far end of the transmission facility.

g. INPUT MONITOR. This indicator lamp lights whenever the incoming test tone is below —40 dBm. The digital display also blanks in such a case. If the input monitor lamp goes out, but the display is blank, the probable cause is a high noise input. Such a condition could raise the input level above —40 dBm without providing a signal stable enough for phase-lock.

REAR PANEL

2.02 The following connections, switch, and fuse appear on the rear panel of the Phase Jitter Test Set (refer to Figure 2-2):

a. POWER CABLE. The power cable is for connection to single-phase ac power, either 115 or 230 volts (±10%).

*Mathematically, per-cycle jitter is the derivative of the total jitter measured in the other two operating modes. Thus, it may also be properly called "frequency jitter." Its dimensions are degrees per cycle.

b. POWER SWITCH. The power switch selects 115 or 230 volt operation. THIS SWITCH MUST BE SET FOR THE VOLTAGE TO BE USED BEFORE THE TEST SET IS PLUGGED IN.

c. FUSE. The fuse receptacle contains the instrument line fuse. The test set is shipped with a 0.5 A fuse for 115 Vac operation. For 230 Vac operation a 0.25 A fuse should be substituted.

d. SIGNAL INPUT. These terminals are in parallel with the "input" jack on the front panel. They may be used instead of the jack to accept the incoming test tone.

e. OUTPUT. These terminals may be used to provide an analog output of the phase jitter being measured to a display device such as an oscilloscope or a spectrum analyzer. The signal available at the OUTPUT terminals is the same signal that drives the digital display. However, with the MODE switch set to P-P FLT IN, the signal will still be present at the OUTPUT terminals, even though the display has blanked because of an out-of-range test tone (outside the frequency range from approximately 980 Hz to 1060 Hz). Under such circumstances, the signal at the OUTPUT terminals presents valid information so long as the test tone is between 600 Hz and 1500 Hz. Outside this test tone range, the accuracy of the OUTPUT signal may be degraded.

3. OPERATION

CONNECTING THE TEST SET

3.01 Connect the Test Set as follows:

a. Set the power switch on the rear panel for the voltage to be used to power the instrument—either 115 or 230 volts ac.

b. Plug the power cord in.

c. Push the POWER switch on the front panel. At this point, with no input signal applied, the INPUT MONITOR and POWER lamps should light, and the digital display should be blank.

d. Apply an incoming test tone to the INPUT jack on the front panel or to the SIGNAL INPUT terminals on the rear panel (do not use both the jack and the terminals simultaneously).

e. If the analog output is to be monitored on another display device, use the OUTPUT terminals on the rear panel to provide the signal to the other device.

PHASE JITTER TESTS

3.02 Once the Test Set is properly connected, the phase jitter measurement can be read directly from the digital display on the front panel of the instrument. The operating mode selected may depend on the type of reading desired. For example, to make a "standard" phase jitter measurement select the P-P FLT IN mode. However, it should be recognized that in this mode the Test Set accepts only a test tone frequency of 1020 Hz ±40 Hz and measures only those jitter components that fall between 20 Hz and 300 Hz of the test tone frequency.

3.03 If a test tone other than 1020 Hz is to be used, select first the P-P FLT OUT mode. This mode measures all the jitter components that can be measured in the P-P FLT IN mode, and it can "see" the effects of components more than 300 Hz above or below the test tone frequency. To check the magnitude of the "frequency jitter" present on the received test tone, select the PEAK/CYCLE mode. This mode emphasizes the high-frequency components.

3.04 Figure 3-1 shows a comparison of the response of the three operating modes to jitter components of various frequencies. These response curves were prepared by using two input tones to simulate phase jitter.

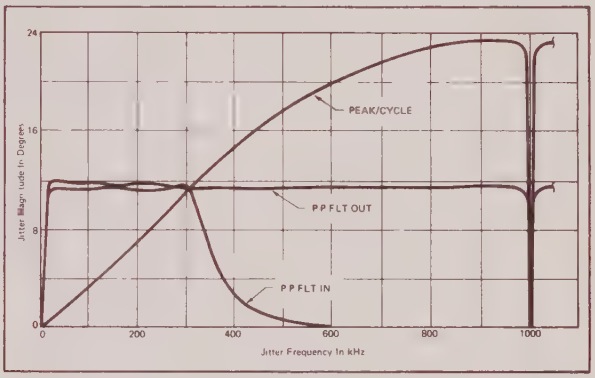


Figure 3-1. Two-Tone Test Jitter Response Curves.

4. SPECIFICATIONS

Input Characteristics

Test	500 Hz to 3 kHz. (1020 Hz ±40 Hz in P-P FLT IN mode).
Level	−40 dBm to +10 dBm.
Impedance	600 or 900 ohms, balanced, switch selectable.
Balance	40 dB.
Protection	DC input: Blocks 300 volts. Spikes: Withstands 600 volts for 3 μsec, either terminal to ground. Longitudinal Voltage: 30 volts rms. Metallic Voltage: 50 volts rms.
Terminal	Front panel jack for 310 plug. Terminal strip on rear panel.
Measurement Modes	a. Total phase jitter—filtered peak-to-peak. b. Total phase jitter—unfiltered peak-to-peak. c. Per-cycle phase jitter—peak.
Display	Digital, 3 Nixie tubes, with overrange indicator.
Range	00.0 to 99.9 degrees.
Resolution	0.1 degree.

Accuracy

P-P FLT IN	±4% of reading ±0.2 degree.
P-P FLT OUT	±5% of reading ±0.2 degree.
PEAK/CYCLE	±5% of reading ±0.2 degree.

Analog Output
- Connection . . . . . Terminal strip on rear panel.
- Level . . . . . 1 volt = 10° ±10%.
- Source Impedance . . . . . 10,000 ohms.

Power Requirement . . . . . 115/230 volts ±10% ac.
45 to 400 Hz.
200 mA.

Size . . . . . Height: 5-1/4 inches.
Width: 7-3/4 inches (8-7/8 inches with handle).
Depth: 11-1/4 inches.

Weight . . . . . 9-1/2 pounds.

Operating Temperature Range . . . . 0° to 50°C.

5. MAINTENANCE AND CALIBRATION

MAINTENANCE

5.01 The only routine preventative maintenance required by the Test Set is periodic calibration. It is recommended that calibration be performed annually. This section contains disassembly and reassembly procedures, and step-by-step calibration instructions for the adjustment of various signals and voltages, and for correct front panel readings. There are certain checks for which there are no adjustments. If any such voltages are found to be out of the specified tolerances, corrective maintenance is required.

5.02 In the event corrective maintenance is required, refer to the Principals of Operation and schematic diagrams of Section 6 and proceed in accordance with normal trouble-locating procedures. The flow diagram, Figure 6-2, with its associated tables of test points and waveforms, has been specially prepared as a trouble-locating aid. Alternatively, see Factory Repair Service in Section 7 of this manual for procedures to be followed in returning the instrument to TTI for repair.

REQUIRED TEST EQUIPMENT

5.03 The test equipment required for calibration of the Test Set is given in Table 5-1. Substitute equipment must meet or exceed the requirements of the test equipment recommended.

WARNING

Exercise extreme caution as 115 Vac and 170 Vdc are present inside the Test Set.

*Table 5-1. *Required Test Equipment*

EQUIPMENT TYPE	MANUFACTURER
Oscilloscope (dual trace) 25 MHz	Tektronix TLD67
Digital Multimeter	Dana 4200
Frequency Counter	ITRON 650/25
Transmission Test Set	TTI 1103
Oscillator (two needed)	HP 651
600-ohm matching pad	See Figure 5-4
14/16-pin Integrated Circuit Test Clip	AP #923700

*Substitutes must be equal to or better than type given.

DISASSEMBLY

5.04 To disassemble the Test Set, proceed as follows (See Figure 5-1):

a. Remove screws ① from rear bezel mounting holes ② .
b. Gently remove rear bezel ③ from the Test Set assembly ④ .
c. Slide top cover ⑤ , side covers ⑥a and ⑥b and bottom cover ⑦ to the rear and away from the Test Set assembly ④ .
d. For ease of handling during test, rear bezel ③ may be reinstalled with screws ① .
e. This completes the disassembly required to gain access to all adjustments within the Test Set.

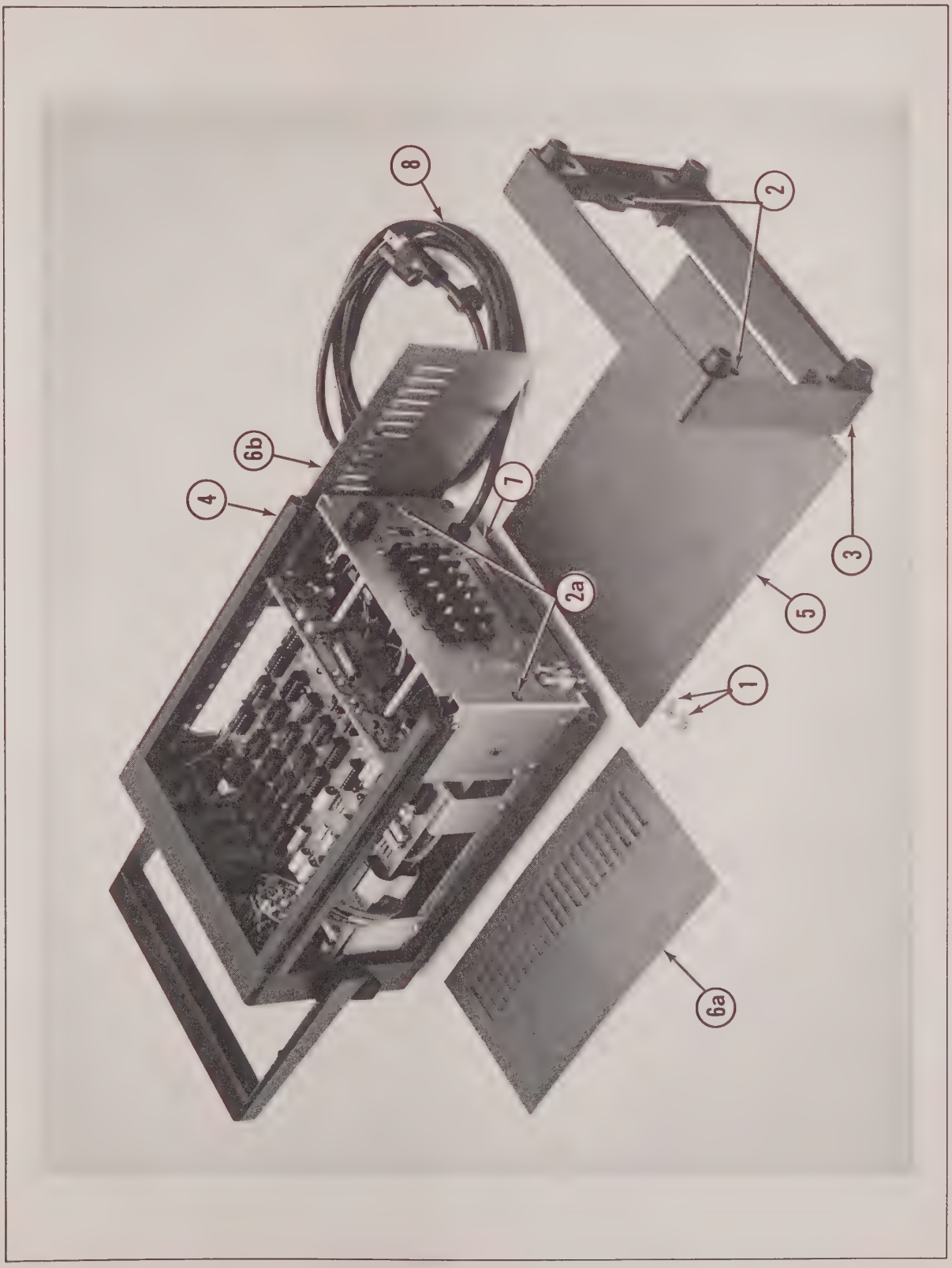


Figure 5-1. TTI 1200 Phase Jitter Test Set, Disassembly/Reassembly.

REASSEMBLY

5.05 To reassemble the Test Set, proceed as follows (See Figure 5-1):

a. Remove rear bezel ③ by removing screws ① .
b. With green paint out, replace top cover ⑤ , side covers ⑥a and ⑥b (with louvers up), and bottom cover ⑦ (with rubber feet down).
c. Route power cable ⑧ through rear bezel ③ and fit bezel into place on the Test Set assembly ④ .
d. Replace screws ① through rear bezel mounting holes ② into pressed-nuts ②a . These screws must be moderately tight.
e. This completes the reassembly of the Test Set. It is now ready for operation.

CALIBRATION PROCEDURES

5.06 The steps in the calibration procedure should be accomplished sequentially, in the order presented.

NOTE 1

The two tones generated by the two oscillators in the test set-up of Figure 5-3 are used to simulate phase jitter. Accurate calibration of the Test Set requires a precise difference between the levels of the two oscillators. Therefore, the oscillators must be adjusted to exactly the levels specified. Ensure the Test Set power switch is turned OFF prior to connecting or disconnecting test equipment and during disassembly and reassembly.

NOTE 2

All test points, circuit boards, and adjustable components can be located by referring to the flow diagram, Figure 6-2.

Power Supply, Circuit Board #3—Calibration

5.07 *+15 Vdc Calibration.* Connect digital voltmeter input to test point V1. Connect digital voltmeter ground input to the GRD terminal.

5.08 If necessary, adjust V1 ADJ (R17) for a +15 Vdc ±0.1 V reading.

5.09 *—15 Vdc Calibration.* Connect digital voltmeter input to test point V2. Connect digital voltmeter ground input to the GRD terminal.

5.10 If necessary, adjust V2 ADJ (R18) for a —15 Vdc ±0.1 V reading.

5.11 *+5 Vdc Verification.* Connect digital voltmeter input to test point V3. Connect digital voltmeter ground input to the GRD terminal.

5.12 Verify a +5 Vdc ±0.25 V reading. No adjustment is possible to the +5 Vdc supply.

5.13 *+170 Vdc Verification* Connect digital voltmeter input to test point 170 V. Connect digital voltmeter ground input to the return terminal.

5.14 Verify a +170 Vdc ±17 V reading. No adjustment is possible to the +170 Vdc supply.

Circuit Board #1—Calibration

5.15 *+10 Vdc Reference Verification.* On circuit board #1 connect digital voltmeter input to IC 20 pin 6. Connect digital voltmeter ground input to the circuit board ground test point (g).

5.16 Verify a +10 Vdc ±0.3 V reading. No adjustment is possible to the +10 Vdc reference voltage supply.

5.17 *1 MHz Oscillator Calibration.* On circuit board #1 connect frequency counter input to IC17 pin 8. Connect frequency counter ground input to the circuit board ground test point (g).

5.18 If necessary, adjust C16 for a 1 MHz ±10 Hz reading.

5.19 *VCO Zeroing.* Connect test oscillator to the Test Set as shown in Figure 5-2. Set the Test Set impedance switch to 600 ohms and the mode selector switch to P-P FLT IN. Jumper terminals "f" to "g" on circuit board #1.

5.20 From the test oscillator, feed a 1-kHz ±0 Hz, —5 dBm ±1 dB, 600-ohm signal into the Test Set.

5.21 If necessary, adjust R35 for a front panel reading of 0.0 to 0.1 degrees. Remove the jumper from terminals "f" to "g".

Circuit Board #2—Calibration

5.22 *Phase Lock Loop 1 and 2 Calibration.* Connect test oscillator as shown in Figure 5-2.

5.23 From the test oscillator feed a 1 kHz, —5 dBm ±1 dB, 600-ohm signal into the Test Set.

5.24 *Phase Lock Loop #1 Calibration.* On circuit board #2 connect oscilloscope probe for trace A to IC21 pin 5. Connect oscilloscope probe for trace B to IC21 pin 6. Connect oscilloscope ground input to the circuit board ground test point (M).

5.25 If necessary, adjust R74 for trailing edge coincidence (negative-going edge). The maximum allowable lag between the trailing edges is one microsecond.

5.26 *Phase Lock Loop #2 Calibration.* On circuit board #2, connect oscilloscope probe for trace A to IC22 pin 5. Connect oscilloscope probe for trace B to IC22 pin 6. Connect oscilloscope ground input to the circuit board ground test point (M).

5.27 If necessary, adjust R75 for trailing edge coincidence (negative-going edge). The maximum allowable lag between the trailing edges is one microsecond.

5.28 *Peak-to-Peak, Detector, and Per Cycle Zeroing Calibration.* Connect test oscillator as shown in Figure 5-2.

5.29 *Peak-to-Peak Calibration.* On circuit board #2, connect oscilloscope input to capacitor C32. Connect oscilloscope ground input to the circuit board ground test point (M). Set the Test Set mode selector switch to P-P FLT IN.

5.30 If necessary, adjust R36 for a 0.0 Vdc ±0.5 V reading. Remove the oscilloscope leads.

5.31 *Detector Zeroing Calibration.* Set the Test Set mode selector switch to P-P FLT IN. If necessary, adjust R19 on circuit board #1, for a front panel reading of 0.0 to 0.1 degrees.

5.32 Set the Test Set mode selector switch to P-P FLT OUT. Verify a front panel reading of not more than 0.2 degrees.

5.33 Set the Test Set mode selector switch to PEAK/CYCLE. If necessary for a stable reading, set the damping switch to HI. Verify a front panel reading of not more than 0.2 degrees.

5.34 *Two-Tone Calibration.* Connect two-tone test circuit as shown in Figure 5-3. To establish the proper two-tone set-up, perform the following steps:

a. Connect tone #1 oscillator 600-ohm output and tone #2 oscillator output to the 600-ohm matching pad.
b. Connect frequency counter to tone #1 oscillator 50-ohm output.
c. Connect TTI 1103 Transmission Test Set and the Phase Jitter Test Set under test to the 600-ohm matching pad output (connect in parallel).
d. Set the TTI 1103 for a 600-ohm bridging measurement.
e. Set the Phase Jitter Test Set impedance switch to 600-ohm.
f. Set tone #2 oscillator output attenuator switch to —70 dB (this effectively removes the oscillator from the test circuit without disconnecting leads).

NOTE

Once oscillator output levels have been established in steps (g) and (j), do not disturb the oscillator course and fine adjustments for the remainder of the calibration set-up.

g. Set tone #1 oscillator output to 1 kHz ±0 Hz as indicated on the frequency counter, and to —5.0 dBm ±0.1 dB as indicated on the TTI 1103.
h. Connect frequency counter to tone #2 oscillator 50-ohm output.

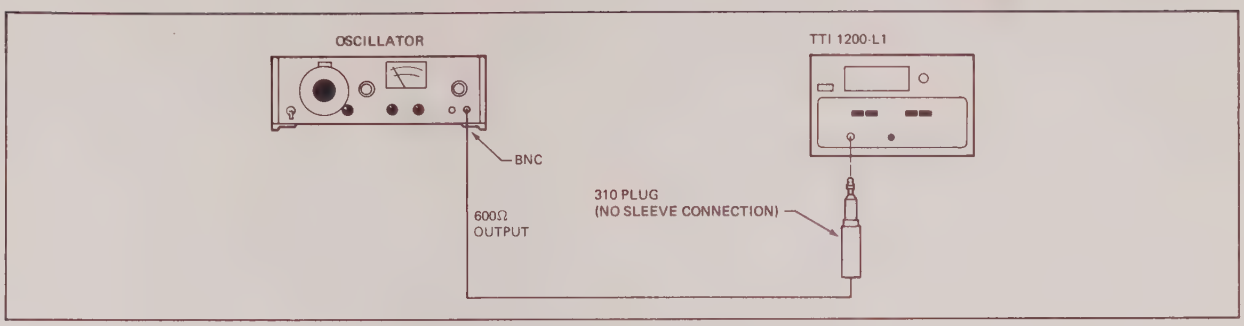


Figure 5-2. Single-Tone Test Set-Up.

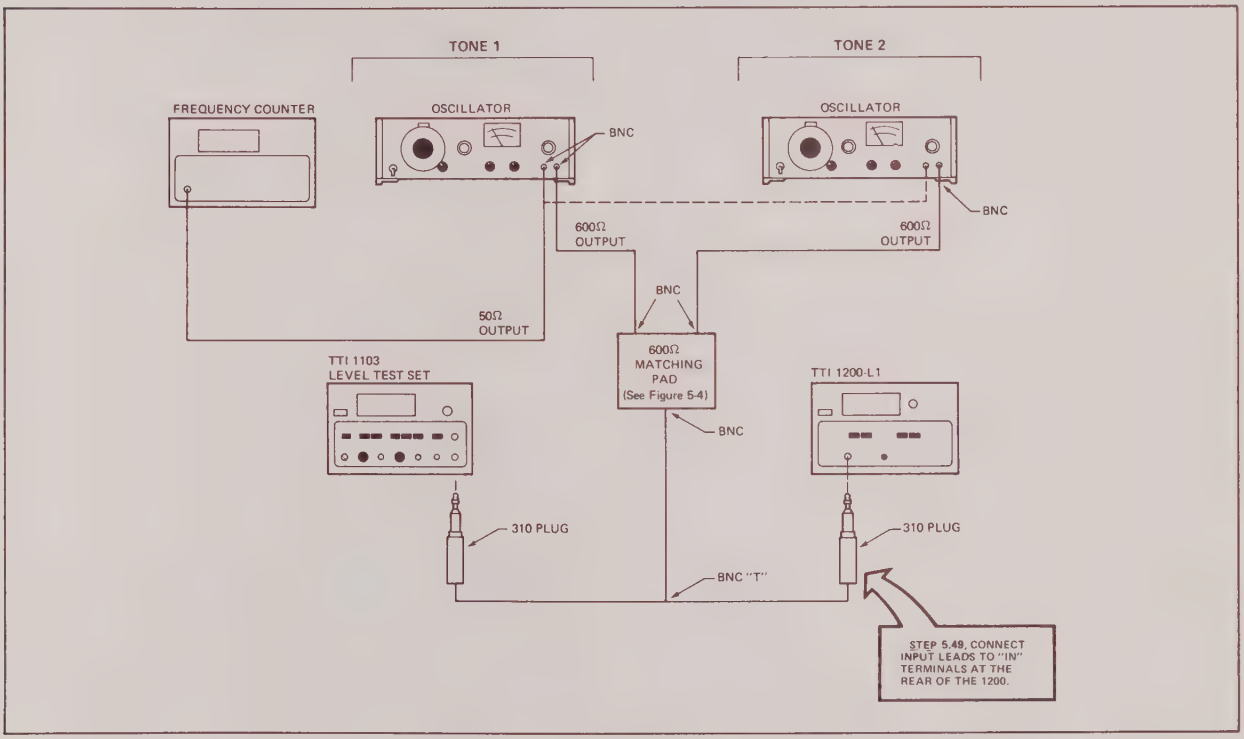


Figure 5-3. Two-Tone Test Set-Up.

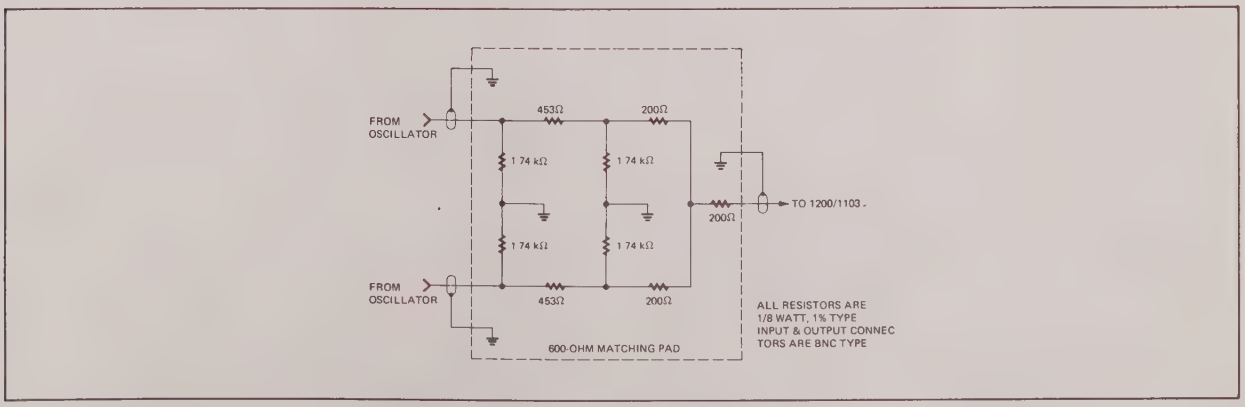


Figure 5-4. 600-Ohm Matching Pad.

NOTE

Note the output attenuator switch position on the test oscillator prior to performing the next step.

i. Set tone #1 oscillator output attenuator switch to −70 dB (this effectively removes the oscillator from the test circuit without disconnecting leads).

j. Set tone #2 oscillator output to 1.1 kHz ±0 Hz as indicated on the frequency counter and to −25 dBm ±0.1 dB as indicated on the TTI 1103.

k. Return tone #1 oscillator output attenuator switch to the position previously set.

l. Proceed with calibration.

5.35 Set the Test Set mode selector switch to PEAK/CYCLE. If necessary for a stable reading, set the DAMPING switch to HI.

5.36 If necessary, adjust R38 on circuit board #2 for a front panel reading of 4.0 degrees.

5.37 Set the mode selector switch to P-P FLT IN.

5.38 Set the DAMPING switch to HI or LO as necessary for a stable reading. If necessary, adjust R69 on circuit board #2 for a front panel reading of 11.4 to 11.5 degrees.

5.39 Set the mode selector switch to P-P FLT OUT.

5.40 If necessary, adjust R11 on circuit board #1 for a front panel reading of 11.4 to 11.5 degrees.

5.41 Set tone #1 to 1 kHz ±0 Hz at −5 dBm ±0.1 dB by performing steps (b), (f) and (g) of paragraph 5.34.

5.42 Set tone #2 to 1.1 kHz ±0 Hz at −18 dBm ±0.1 dB by performing steps (h) thru (k) of paragraph 5.34.

5.43 Verify a 25.9 degree ±0.8 degree front panel reading by performing the switching functions only in steps 5.37, 5.38, and 5.39.

5.44 Frequency Response. Connect the two-tone test circuit to the Test Set as shown in Figure 5-3.

5.45 Set tone #1 to 1 kHz, ±0 Hz at −5 dBm ±0.1 dB by performing steps (b), (f), and (g) of paragraph 5.34.

5.46 Set tone #2 to 1010 Hz ±0 Hz at −25 dBm ±0.1 dB by performing steps (h) thru (k) of paragraph 5.34.

5.47 Set the mode selector switch to P-P FLT IN. Adjust tone #2 to 2700 Hz ±0 Hz. Adjust L1 on circuit board #2 for a displayed reading of 2.8 to 2.9 degrees. Adjust tone #2 to the frequency given in the FREQUENCY column of Table 5-2, and verify the reading in the TOLERANCE column. Steps (h) thru (k) of paragraph 5.34 must be performed for each frequency given in Table 5-2.

Table 5-2. Frequency Response (P-P FLT IN)

FREQUENCY	TOLERANCE
1010 Hz ±0 Hz	5.0 degrees (maximum)
1020 Hz ±0 Hz	11.0 to 12.0 degrees
1030 Hz ±0 Hz	11.0 to 12.0 degrees
1100 Hz ±0 Hz (20 dB S/N)	11.0 to 12.0 degrees
1200 Hz ±0 Hz	11.0 to 12.0 degrees
1270 Hz ±0 Hz	11.0 to 12.0 degrees
1300 Hz ±0 Hz	11.0 to 12.0 degrees
1500 Hz ±0 Hz	2.0 degrees maximum
2700 Hz ±0 Hz	3.0 degrees maximum
1100 Hz ±0 Hz (~~12~~ dB S/N)	29.0 to 31.3 degrees

1.726 OR 12 dB S/N JEFF BARUCH

5.48 Set the Test Set mode selector switch to P-P FLT OUT. Adjust tone #2 to the frequencies given in the FREQUENCY column of Table 5-2 and verify the reading in the TOLERANCE column. Steps (h) thru (k) of paragraph 5.34 must be performed for each frequency given in Table 5-2.

Miscellaneous Tests

5.49 Connect test oscillator as shown in Figure 5-3 by connecting input leads to the IN terminals at the rear of the Test Set.

5.50 Apply a 1 kHz ±0 Hz signal at —5 dBm ±1.0 dB and 600 ohms.

5.51 *Damping.* Set DAMPING switch to HI. Rapidly vary input frequency approximately 100 Hz either side of the 1-kHz test tone. The front panel reading should NOT change more than once per second. Repeat the test with the DAMPING switch set to LO. The display should change 10 times as fast as in the HI mode.

5.52 *Power Indicator.* Turn the Test Set power switch to ON, then to OFF. The POWER indicator should glow when power is ON and should be extinguished when power is OFF.

5.53 *Input Monitor.* Remove input jack. Input monitor indicator should glow. Insert input jack, input monitor should be extinguished.

5.54 *Unblanking.* Apply a test signal within the operating limits of the Test Set. The front panel display should unblank and present a reading within 1 to 3 seconds from the time of signal insertion.

5.55 Set the mode selector switch to P-P FLT IN. Set input frequency to 1200 Hz. By decreasing the input frequency the display should unblank at 1055 Hz or higher.

5.56 Set input frequency to 700 Hz. By increasing the input frequency, the display should unblank at 985 Hz or lower.

5.57 This concludes calibration and test of the Phase Jitter Test Set. Remove all test equipment and reassemble the Test Set by referring to the reassembly procedures contained in Paragraph 5.05 of this section.

6. PRINCIPALS OF OPERATION

6.01 The input signal to the Test Set may be supplied through the front-panel INPUT jack or the INPUT terminals on the rear panel. (The rear-panel terminals are directly in parallel with the tip and ring contacts on the INPUT jack.) In either case, the ac signal is applied to the primary winding of the input transformer, as shown in the flow diagram, Figure 6-2. The front-panel IMPEDANCE switch selects one of two taps on the primary winding to provide a balanced input impedance of 600 or 900 ohms.

6.02 The secondary winding of the input transformer applies the signal to the input filters, which operate in tandem. The first filter is a three-pole, 300-Hz highpass, which is always in the signal path. The second filter is a four-pole, 1800-Hz lowpass, which is in the signal path only when the front-panel MODE switch is in the P-P FLT IN position. When the MODE switch is in either of the other two positions (P-P FLT OUT or PEAK/CYCLE), there is no lowpass input filtering in the signal path.

6.03 After input filtering, the signal is routed to the limiter and to the signal detector. If the input signal level is below —40 dBm, the signal detector causes the INPUT MONITOR on the front panel to light. The signal detector also enables the display blanking logic, which switches off the Nixie supply voltage, blanking the numerical display. If the signal level is above —40 dBm, but is not stable enough for the Test Set to provide a valid reading, the signal detector enables the display blanking logic but does not cause the INPUT MONITOR to light.

6.04 The same signal that is applied to the signal detector is also applied to the limiter. The limiter amplifies the signal (which is normally a sinewave) and clips it to form a squarewave of the same frequency and phase.

6.05 The squarewave from the limiter is applied to two phase-lock loops* which generate "reference half-cycles" that have the same duration as the average half-cycle of the input test tone. These reference half-cycles are the standard for comparing individual half-cycles of the input test tone to determine the per-cycle jitter. One of the two phase-lock loops generates the reference half-cycle for comparison to the positive half-cycle of the squarewave that is drived from the input signal. The other phase-lock loop generates the reference half-cycle for comparison to the negative half-cycle of the squarewave.

6.06 If the individual half-cycles of the received squarewave match the internally generated

*U.S. PATENT APPLIED FOR

reference half-cycles, the phase-lock loops produce no output. However, if an individual half-cycle period of the received squarewave does not match the reference half-cycle, the phase-lock loop that is measuring that particular period produces an error pulse. The width of the error pulse is proportional to the difference between that specific half-cycle period and the reference half-cycle period, as shown in Figure 6-1. Since the two phase-lock loops measure alternate half-cycles, an error pulse is generated twice per cycle (assuming that jitter is present on the input test tone). Thus, the two phase-lock loops together produce a pulse train with a repetition rate at twice the frequency of the input test tone. This pulse train is applied to the peak/cycle pulse converter and to the peak-to-peak integrator.

6.07 Both phase-lock loops receive +10 Vdc from the 10-volt reference generator. This precision voltage ensures that all error pulses have the same height. In other words, the error information from the phase-lock loops is supplied in the form of pulse duration modulation (PDM), and it contains no pulse amplitude modulation (PAM). The 10-volt reference generator also supplies the same precision voltage to the VCO (described in Paragraph 6.15) to establish a constant amplitude for the VCO feedback signal. This constant-amplitude feedback signal maintains the linearity of the voltage-to-frequency conversion process.

6.08 Phase-lock loop No. 2 furnishes two outputs in addition to error pulses. One of these outputs is a dc voltage that is proportional to the average frequency of the input test tone. This dc voltage is supplied to the peak/cycle pulse converter and to the peak-to-peak integrator. The other output from phase-lock loop No. 2 is a pulse train with a repetition rate equal to the frequency of the input signal. This pulse train goes to the out-of-frequency detector, which monitors the frequency of the input test tone when the Test Set is operating in the P-P FLT IN mode. When the input test tone frequency goes above or below the range from approximately 980 Hz to 1060 Hz, the out-of-frequency detector enables the display blanking logic. This causes the display blanking control to switch

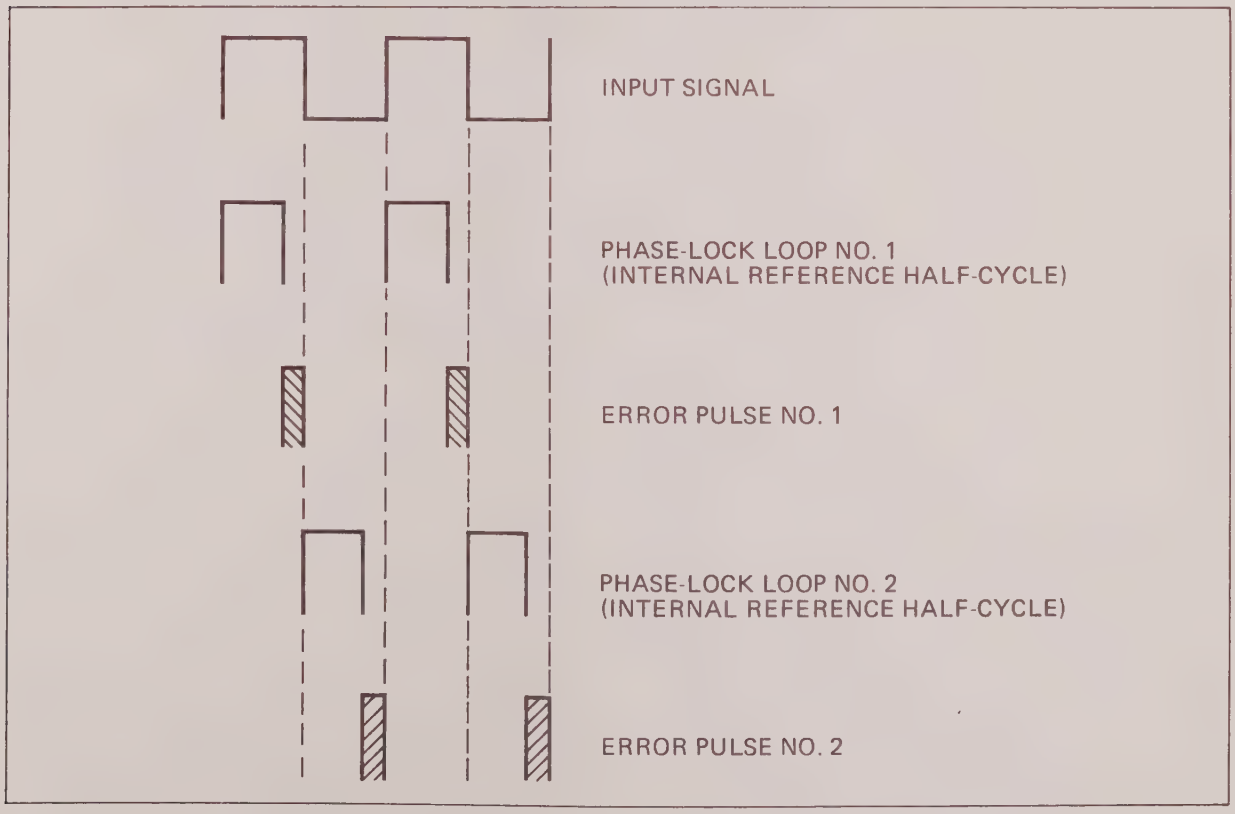


Figure 6-1. Generation of Error Pulses by Phase-Lock Loops.

off the Nixie supply voltage, blanking the display. The out-of-frequency detector is inhibited when the Test Set is operating in either the P-P FLT OUT or the PEAK/CYCLE mode.

6.09 The error pulses from the two phase-lock loops are applied to the peak/cycle pulse converter and to the peak-to-peak integrator. The peak/cycle pulse converter functions as a PDM-to-PAM converter. The height of the pulses it produces is proportional to the width of the pulses it receives from the phase-lock loops. When the Test Set is operating in the PEAK/CYCLE mode, the output from the peak/cycle pulse converter is applied directly to the peak-to-peak detector. This same output is also applied to the display blanking logic, which monitors the amount of peak/cycle phase jitter. If the peak/cycle jitter exceeds approximately 90 degrees, the display blanking logic causes the display blanking control to switch off the Nixie supply voltage, blanking the display.

6.10 The peak/cycle pulse converter also receives a dc voltage from phase-lock loop No. 2. This voltage, which is proportional to the average frequency of the input test tone, scales the height of the pulses produced by the peak/cycle pulse converter. For example, if the input frequency is 1 kHz, 10 degrees of jitter will be represented by a particular width of the error pulse from the phase-lock loop. If the input test tone frequency is 2 kHz, an error pulse of one-half the width will represent 10 degrees of jitter. Thus, the dc voltage is used to adjust the height of the pulses from the peak/cycle integrator so that a particular pulse width modulation always represents a particular amount of jitter, regardless of the input frequency. Thus, the area under the error pulse (width times height) remains constant.

6.11 Error pulses from the two phase-lock loops are also applied to the peak-to-peak integrator, which integrates (sums) the error pulses. While the polarity of all error pulses is the same, the pulses are applied to the positive or negative input of the peak-to-peak integrator, depending upon the direction of the error measured by the phase-lock loops (whether the half-cycle period of the squarewave is longer or shorter than the average half-cycle period of the input signal). Thus, the output of the peak-to-peak integrator is a PAM signal which at any instant represents the cumulative phase excursion of the input test tone.

6.12 The peak-to-peak integrator also receives a dc voltage (proportional to frequency) from phase-lock loop No. 2. This voltage is used for scaling just as it is in the peak/cycle pulse converter (see Paragraph 6.10).

6.13 When the Test Set is operating in the P-P FLT IN mode, the output from the peak-to-peak integrator passes through a pair of active filters, operating in tandem, before being applied to the peak-to-peak detector. The first of these filters is a 3-pole, 20-Hz highpass. The second is a 4-pole, 300-Hz lowpass. In the P-P FLT OUT mode, the 300-Hz lowpass filter is removed from the signal path, and the output from the peak-to-peak integrator is coupled directly to the peak-to-peak detector.

6.14 The peak-to-peak detector receives amplitude-modulated pulses from the peak/cycle pulse converter, the peak-to-peak integrator, or the output filters, depending on the operating mode of the Test Set. The peak-to-peak detector produces a dc output voltage that is proportional to the peak-to-peak amplitude of the input pulses. This output voltage is applied to the voltage-controlled oscillator (VCO).

6.15 In addition to the dc voltage from the peak-to-peak detector, the VCO receives a +10 Vdc reference from the 10-volt reference generator. The reference voltage maintains the VCO feedback signal at a constant amplitude. The VCO output is a train of pulses, 50 microseconds wide, with the pulse repetition rate proportional to the dc input from the peak-to-peak detector. For each 1-volt change in the input to the VCO, the output frequency changes by 100 Hz when the front-panel DAMPING switch is "in". When the DAMPING switch is "out", the VCO sensitivity is 1 kHz per volt. The VCO output is gated into the tenths counter by the time-base gate pulse.

6.16 The time-base gate pulse originates in the 1-MHz oscillator. The squarewave from the crystal-controlled 1-MHz oscillator goes to the divider, where it is divided by 10^5 or 10^6, depending on the position of the DAMPING switch. With damping "out", the divider produces a time-base gate pulse with a duration of 0.1 second. With damping in, the duration of the time-base gate pulse is 1 second.

6.17 When the time-base gate pulse is HIGH, the VCO signal is gated into the tenths counter by the gating logic. The tenths counter counts the positive half-cycles of the VCO signal until it reaches a binary count of nine. Then the tenths counter resets and transfers one digit to the units counter. When the units counter reaches a binary count of nine, it resets and transfers one digit to the tens counter. If the tens counter reaches a count of nine, it transfers one digit to the overrange control indicator, which lights the overrange indicator in the tens Nixie tube (left side decimal point). While the counters are operating, they are continuously updating the BCD output storage logic. Each of the three counters has four parallel outputs to form a standard 8-4-2-1 binary-coded decimal (BCD) format.

6.18 When the time-base gate pulse goes LOW, the tenths counter no longer receives the VCO signal, and the contents of the BCD output storage logic are transferred to the decoder drivers. Each decoder driver translates the BCD signal into straight decimal form (for example, a simultaneous BCD "4" and BCD "2" translate to a decimal "6") to light the appropriate element in the associated Nixie tube.

*POWER SUPPLY–CIRCUIT BOARD #3–TEST POINTS

TEST POINT	ADJUSTMENT	FUNCTION	SIGNAL APPEARANCE (APPROXIMATE)
V1	R17	+15 Vdc ±.1 Vdc	DC
V2	R18	–15 Vdc ±.1 Vdc	DC
V3	NONE	+5 Vdc ±.2 Vdc	DC
+170	NONE	+170 Vdc ±17 Vdc	+170 Vdc Unregulated

*CIRCUIT BOARD #2–TEST POINTS

TEST POINT	ADJUSTMENT	FUNCTION	SIGNAL APPEARANCE (APPROXIMATE)
IC21-5 (trace A) IC21-6 (trace B)	R74	Phase Lock Loop #1 Alignment	On Scope Trace A On Scope Trace B
IC22-5 (trace A) IC22-6 (trace B)	R75	Phase Lock Loop #2 Alignment	On Scope Trace A On Scope Trace B
C32 (See Circuit Board #2 drawing at right for location of test lead.)	R36	Peak to Peak Integrator-Zeroing	DC with zero phase jitter on input signal
IC2-6	R5	Frequency Blanking VCO	
Proper Front Panel Reading	R69	Peak to Peak Filter In-Calibration	4.0 degree reading
Proper Front Panel Reading	R51	Frequency Compensation to Phase Lock Loop	FACTORY ADJUSTMENT ONLY
Proper Front Panel Reading	L1	300-Hz Lowpass Filter, Slope Adjust.	FACTORY ADJUSTMENT ONLY
Proper Front Panel Reading	R38	Pk/Cycle Calibration	4.0 degree reading

*CIRCUIT BOARD #1–TEST POINTS

TEST POINT	ADJUSTMENT	FUNCTION	SIGNAL APPEARANCE (APPROXIMATE)
IC17-8	C23	1 MHz clock	
f	R35	VCO Zeroing	Normally ground during test. 0 Vdc to –10 Vdc during operation (proportional to jitter; 10 Vdc = 100°). Display reads 0.0 to 0.1 degrees when zeroed.
IC11-3	NONE	+10 Vdc Reference ±.3 Vdc	DC
Proper Front Panel Reading	R19	Detector Zeroing	0.0 to 0.1 degree reading
Proper Front Panel Reading	R11	Peak to Peak Filter Out-Calibration	11.4 to 11.5 degree reading

*For proper adjustment, refer to the calibration procedures in section 5 of this manual.

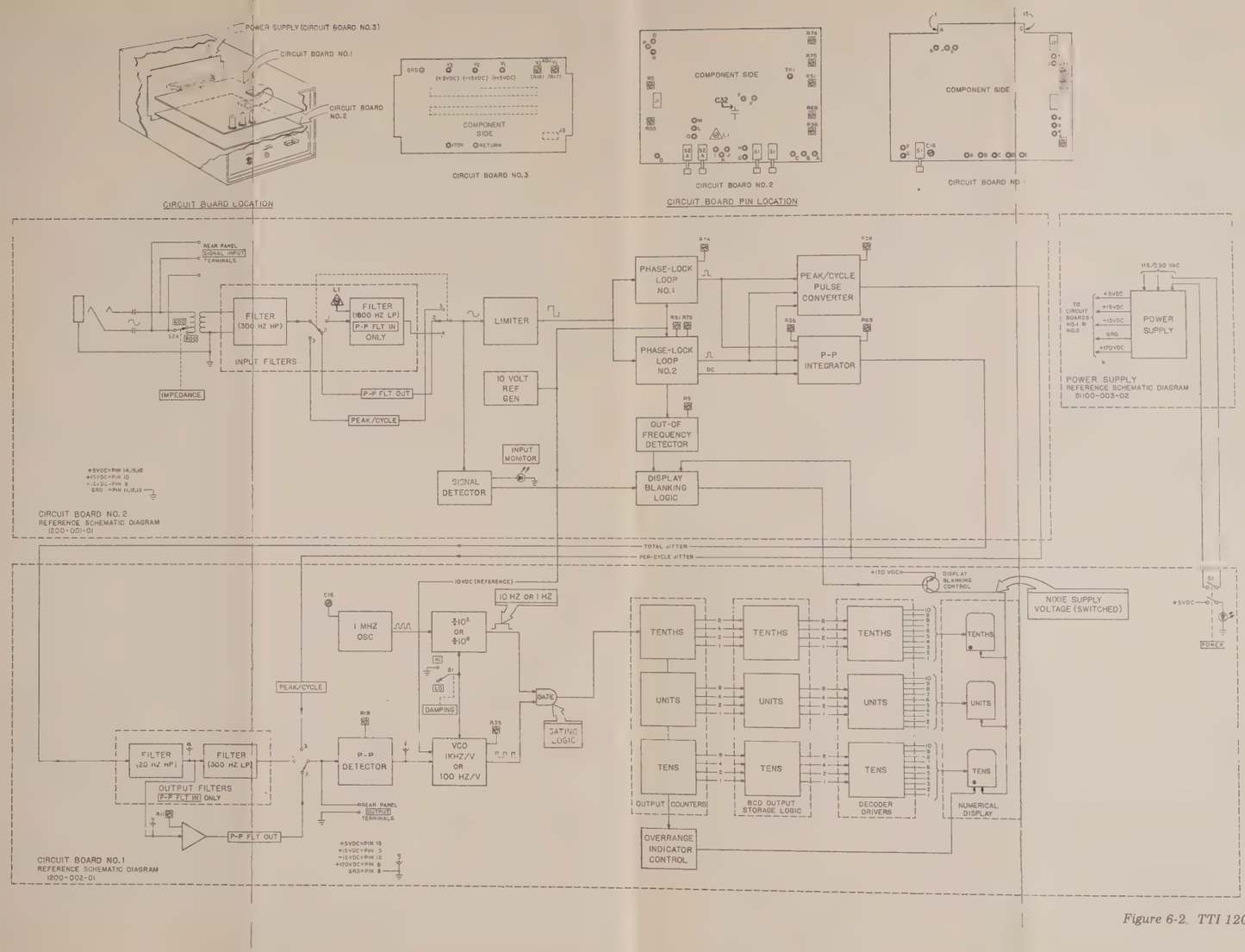


Figure 6-2. TTI 1200-L1 Flow Diagram.

7. FACTORY REPAIR SERVICE

7.01 TTI maintains a complete facility to repair any TTI instrument, whether or not the necessary repair is covered by the warranty.

MALFUNCTION REPORT

7.02 Any instrument returned to the factory for repair, whether covered by warranty or not, should be accompanied by the malfunction report (the following page of this manual). This report should be completed in as much detail as possible to assure quick and complete correction at the factory.

SHIPPING INSTRUCTIONS

7.03 Make sure the instrument is adequately packed to prevent damage in transit. TTI will not be responsible for such damage. If possible, the instrument should be returned in its original shipping container. If this is not possible, use a shipping container that allows for at least four inches of high-quality packing material on every side of the instrument. Ship the instrument prepaid to

Telecommunications Technology, Inc.
555 Del Rey
Sunnyvale, California 94086

The tear-out shipping label on the malfunction report may be used.

CHARGES

7.04 The warranty does not cover shipping charges to the TTI factory. However, if the instrument is in warranty, TTI will pay the cost of surface shipment from the factory.

7.05 If the instrument is not in warranty, TTI will bill for the repair at normal rates. Shipping costs will be billed at TTI's cost.

In the event of malfunction, please complete this report and return it in the shipping container with the instrument. A shipping label is attached for your convenience.

Company _____

Dept. _____

Address _____

_____

Instrument Model # _____

Serial # _____

TTI Shipping Date _____

From _____

_____

_____

To: Telecommunications Technology, Inc.
555 Del Rey
Sunnyvale, California 94086

(Shipping date appears inside rear cover of instruction manual. Warranty expires one year from this date.)

☐ Please furnish estimate before proceeding with repair.

DETAILED DESCRIPTION OF MALFUNCTION

Signature _____

Title _____

8. PARTS LISTS

8.01 Tables 8-1 through 8-6 list the parts used in the Test Set. For electronic components, the reference designation shown in the "REF DES" column on the parts list corresponds to the component number shown on the schematic drawing and to the number shown on the parts locating diagram (adjacent to the schematic).

8.02 Item numbers in the "ITEM NO." column, at the end of each parts list table, refer to items not shown on the schematic, such as integrated circuit sockets. Such items are identified on the parts locating diagrams by the symbol ⬭.

Table 8-1. Circuit Board #1 Parts List

ASSEMBLY NAME PHASE JITTER BOARD #1.
ASSEMBLY NUMBER D-P1200-013-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
C1		910500028	CAPACITOR, MET. POLYCARB, .22UF, 1%, 100V	2	
C2		910500028	CAPACITOR, MET. POLYCARB, .22uf, 1%, 100V		
C3		910500029	CAPACITOR, MET. POLYCARB, .027uf, 1%, 100V	4	
C4		910500029	CAPACITOR, MET. POLYCARB, .027uf, 1%, 100V		
C5		910500029	CAPACITOR, MET. POLYCARB, .027uf, 1%, 100V		
C6		910500029	CAPACITOR, MET. POLYCARB, .027uf, 1%, 100V		
C7		910100018	CAPACITOR, DISC 200pf, 1KV	1	
C8		910200003	CAPACITOR, ELECTROLYTIC N.P. 5uf, 30V	4	
C9		910200003	CAPACITOR, ELECTROLYTIC N.P. 5uf, 30V		
C10		910500032	CAPACITOR, MET. POLYCARB, 39uf, 1%, 100V	1	
C11		910200003	CAPACITOR, ELECTROLYTIC N.P. 5uf, 30V		
C12		910200003	CAPACITOR, ELECTROLYTIC N.P. 5uf, 30V		
C13		910100004	CAPACITOR, DISC .05uf, 25V	11	
C14		910500016	CAPACITOR, MYLAR .027uf, 100V	1	
C15		910500027	CAPACITOR, POLYCARB, 2200pf, 200V	1	
C16		912200001	CAPACITOR, TRIMMER 5,5 - 18pf	1	
C17		910400014	CAPACITOR, MICA 15pf	1	
C18		910100001	CAPACITOR, DISC .0022uf	1	
C19		910100003	CAPACITOR, DISC .01uf, 50V	2	
C20		910100003	CAPACITOR, DISC .01uf, 50V		
C21		910100005	CAPACITOR, DISC .1uf, 10V	6	
C22		910100004	CAPACITOR, DISC .05uf, 25V		
C23		910100004	CAPACITOR, DISC .05uf, 25V		
C24		910100004	CAPACITOR, DISC .05uf, 25V		
C25		910100004	CAPACITOR, DISC .05uf, 25V		
C26		910100004	CAPACITOR, DISC .05uf, 25V		
C27		910100004	CAPACITOR, DISC .05uf, 25V		
C28		910100004	CAPACITOR, DISC .05uf, 25V		
C29		910100004	CAPACITOR, DISC .05uf, 25V		
C30		910100004	CAPACITOR, DISC .05uf, 25V		
C31		910100004	CAPACITOR, DISC .05uf, 25V		

Table 8-1. (Continued)

ASSEMBLY NAME PHASE JITTER BOARD #1
ASSEMBLY NUMBER D-P1200-013-01

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
C32		910100005	CAPACITOR, DISC .1uf, 10V		
C33		910100005	CAPACITOR, DISC .1uf, 10V		
C34		910100005	CAPACITOR, DISC .1uf, 10V		
C35		910100005	CAPACITOR, DISC .1uf, 10V		
C36		910100005	CAPACITOR, DISC .1uf, 10V		
IC1		952000011	IC, LINEAR SN72741P	7	
IC2		952000011	IC, LINEAR SN72741P		
IC3		952000011	IC, LINEAR SN72741P		
IC4		952000011	IC, LINEAR SN72741P		
IC5			NOT USED		
IC6			NOT USED		
IC7		952000011	IC, LINEAR SN72741P		
IC8		952000011	IC, LINEAR SN72741P		
IC9		952000011	IC, LINEAR SN72741P		
IC10			NOT USED		
IC11		950200001	IC, UTILOGIC SIGNETIC SP301A	1	
IC12			NOT USED		
IC13		950200019	IC, MULTIVIBRATOR SN74121	1	
IC14		950200020	IC, DUAL SCHMITT TRIGGER SN7413	1	
IC15		950200002	IC, 2-INPUT QUAD NAND GATE SN7400	1	
IC16		950200004	IC, HEX INVERTER SN7404	1	
IC17		950200005	IC, HEX INVERTER OPEN COLLECTOR SN7405	1	
IC18		950200010	IC, DECADE COUNTER SN7490	9	
IC19		950200010	IC, DECADE COUNTER SN7490		
IC20		950200010	IC, DECADE COUNTER SN7490		
IC21		950200010	IC, DECADE COUNTER SN7490		
IC22		950200010	IC, DECADE COUNTER SN7490		
IC23		950200021	IC, DIVIDE-BY-TWELVE COUNTER SN7492	1	
IC24		950200010	IC, DECADE COUNTER SN7490		
IC25		950200010	IC, DECADE COUNTER SN7490		

Table 8-1. (Continued)

ASSEMBLY NAME PHASE JITTER BOARD #1.
ASSEMBLY NUMBER D-P1200-013-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
IC26		950200010	IC, DECADE COUNTER SN7490		
IC27		950200008	IC, 4-BIT BISTABLE LATCH SN7475	3	
IC28		950200008	IC, 4-BIT BISTABLE LATCH SN7475		
IC29		950200008	IC, 4-BIT BISTABLE LATCH SN7475		
IC30		950200015	IC, DECODER/DRIVER SN74141	3	
IC31		950200015	IC, DECODER/DRIVER SN74141		
IC32		950200015	IC, DECODER/DRIVER SN74141		
IC33		950200010	IC, DECADE COUNTER SN7490		
IC34		950200014	IC, DUAL JK FLIP-FLOP SN74107	1	
NX1		971800001	NIXIE TUBE, BURROUGHS B5870-ST	3	
NX2		971800001	NIXIE TUBE, BURROUGHS B5870-ST		
NX3		971800001	NIXIE TUBE, BURROUGHS B5870-ST		
Q1		960100008	TRANSISTOR PNP 2N5138	1	
Q2		962000002	TRANSISTOR NPN 2N3565	1	
Q3		962000004	TRANSISTOR PNP 2N5140	1	
Q4		*962000005	TRANSISTOR NPN 2N5134	2	
Q5		962000005	TRANSISTOR NPN 2N5134		
Q6			NOT USED		
Q7			NOT USED		
Q8		960100015	TRANSISTOR NPN HV MOTOROLA MM3002	1	
Q9		910100016	TRANSISTOR PNP HV MOTOROLA MM4002	1	
Q10		960100003	TRANSISTOR NPN 2N4945	1	
R1		930504642	RESISTOR, METAL FILM 46.6K, 1%, 1/8W	1	
R2		930504752	RESISTOR, METAL FILM 47.5K, 1%, 1/8W	1	
R3		930501823	RESISTOR, METAL FILM 182K, 1%, 1/8W	1	

Table 8-1. (Continued)

ASSEMBLY NAME PHASE JITTER BOARD NO. 1.
ASSEMBLY NUMBER D-P1200-013-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
R4		930502153	RESISTOR, METAL FILM 215K, 1%, 1/8W	1	
R5		930501372	RESISTOR, METAL FILM 13.7K, 1%, 1/8W	1	
R6		930502152	RESISTOR, METAL FILM, 21.5K, 1%, 1/8W	1	
R7		930501003	RESISTOR, METAL FILM 100K, 1%, 1/8W	3	
R8		930504992	RESISTOR, METAL FILM 49.9K, 1%, 1/8W	3	
R9		930501182	RESISTOR, METAL FILM 11.8K, 1%, 1/8W	1	
R10		930505232	RESISTOR, METAL FILM 52.3K, 1%, 1/8W	1	
R11		920200203	RESISTOR, VARIABLE MULTI-TURN 20K	1	
R12		930501503	RESISTOR, METAL FILM, 150K, 1%, 1/8W	1	
R13		930507502	RESISTOR, METAL FILM 75K, 1%, 1/8W	1	
R14		930504991	RESISTOR, METAL FILM 4.99K, 1%, 1/8W	1	
R15			NOT USED		
R16		930509092	RESISTOR, METAL FILM, 90.9K, 1%, 1/8W	1	
R17		930501502	RESISTOR, METAL FILM, 15.0K, 1%, 1/8W	2	
R18		930501210	RESISTOR, METAL FILM 121 OHMS, 1%, 1/8W	2	
R19		920200102	RESISTOR, VARIABLE MULTI-TURN 1K	1	
R20		930501210	RESISTOR, METAL FILM 121 OHMS, 1%, 1/8W		
R21		930501502	RESISTOR, METAL FILM 15.0K, 1%, 1/8W		
R22		930501002	RESISTOR, METAL FILM, 10K, 1%, 1/8W	1	
R23		930502211	RESISTOR, METAL FILM, 2.21K, 1%, 1/8W	1	
R24		930700332	RESISTOR, COMP. 3.3K, 5%, 1/4W	2	
R25		930700332	RESISTOR, COMP, 3.3K, 5%, 1/4W		
R26		930504872	RESISTOR, METAL FILM, 48.7K, 1%, 1/8W	1	

Table 8-1. (Continued)

ASSEMBLY NAME PHASE JITTER BOARD #1
ASSEMBLY NUMBER D-P1200-013-01

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
R27		930700103	RESISTOR, COMP, 10K, 5%, 1/4W	4	
R28		930504422	RESISTOR, METAL FILM, 44.2K, 1%, 1/8W	1	
R29		930605492	RESISTOR, METAL FILM, 54.9K, 1%, 1/8W	2	
R30		930605492	RESISTOR, METAL FILM, 54.9K, 1%, 1/8W		
R31		930504992	RESISTOR, METAL FILM, 49.9K, 1%, 1/8W		
R32		930501003	RESISTOR, METAL FILM, 100K, 1%, 1/8W		
R33		930504992	RESISTOR, METAL FILM, 49.9K, 1%, 1/8W		
R34		930501003	RESISTOR, METAL FILM, 100K, 1%, 1/8W		
R35		920100103	RESISTOR, VARIABLE MULTI-TURN 10K	1	
R36		930502002	RESISTOR, METAL FILM 20.0K, 1%, 1/8W	1	
R37		930503651	RESISTOR, METAL FILM, 3.65K, 1%, 1/8W	1	
R38		930700122	RESISTOR, COMP. 1.2K, 5%, 1/4W	2	
R39		930700122	RESISTOR, COMP. 1.2K, 5%, 1/4W		
R40		930503242	RESISTOR, METAL FILM, 32.4K, 1%, 1/8W	1	
R41		930700222	RESISTOR, COMP. 2.2K, 5%, 1/4W	3	
R42		930700681	RESISTOR, COMP. 680 OHMS, 5%, 1/4W	1	
R43		930700821	RESISTOR, COMP, 820 OHMS, 5%, 1/4W	1	
R44		930700152	RESISTOR, COMP. 1.5K, 5%, 1/4W	1	
R45 to			NOT USED		
R62			NOT USED		
R63		930700561	RESISTOR, COMP. 560 OHMS, 5%, 1/4W		
R64		930700222	RESISTOR, COMP. 2.2K, 5%, 1/4W		
R65		930700561	RESISTOR, COMP. 560 OHMS, 5%, 1/4W	2	
R66		930700222	RESISTOR, COMP. 2.2K, 5%, 1/4W		
R67		930700103	RESISTOR, COMP. 10K, 5%, 1/4W		
R68		930700124	RESISTOR, COMP. 120K, 5%, 1/4W	2	
R69		930700103	RESISTOR, COMP. 10K, 5%, 1/4W		
R70		930700103	RESISTOR, COMP. 10K, 5%, 1/4W		
R71		930700562	RESISTOR, COMP. 5.6K, 5%, 1/4W	2	
R72		930700184	RESISTOR, COMP. 180K, 5%, 1/4W	1	
R73		930700562	RESISTOR, COMP. 5.6K, 5%, 1/4W		
R74		930700124	RESISTOR, COMP. 120K, 5%, 1/4W		
R75		930700271	RESISTOR, COMP. 270 OHMS, 5%, 1/4W	1	

Table 8-1. (Continued)

ASSEMBLY NAME PHASE JITTER BOARD #1.
ASSEMBLY NUMBER D-P1200-013-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
S1		971600001	SWITCH, PUSH BUTTON DPDT	1	
Y1		970500001	CRYSTAL, 1 MHz	1	
	1	971400001	IC SOCKET, 14 PIN DUAL-IN-LINE	18	
	2	971100002	PAD, TRANSISTOR MOUNTING	2	
	3	971700003	TIE POINTS	1	
	4	971400004	SOCKET, NIXIE TUBE	3	
	5	971600002	IC SOCKET, 16 PIN DUAL-IN-LINE	7	
	6	971400007	IC SOCKET, 8 PIN UDAL-IN-LINE	7	
	7	D-P1200-012-01	PRINTED CIRCUIT BOARD #1,	1	
	8	AWG 22	WIRE, JUMPER	AR	

ISSUE E CHANGE ORDER 169

LEGEND:

AR = As Required
C = Capacitor
CR = Diode
F = Fuse
IC = Integrated Circuit
L = Inductor (Choke)
NX = Display Tube
Q = Transistor
R = Resistor
S = Switch
T = Transformer
Y = Cyrstal

Table 8-2. Circuit Board #2 Parts List

ASSEMBLY NAME PHASE JITTER BOARD #2.
ASSEMBLY NUMBER D-P1200-015-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
C1		910500035	CAPACITOR, MYLAR .82UF 200V 5%	1	
C2		910500034	CAPACITOR, MYLAR 1.0UF 200V 5%	1	
C3		910500030	CAPACITOR, POLYCARB .01UF 100V 1%	4	
C4		910500030	CAPACITOR, POLYCARB .01UF 100V 1%		
C5		910200022	CAPACITOR, DISK 0.1UF 25V	17	
C6		910200022	CAPACITOR, DISK 0.1UF 25V		
C7		910500030	CAPACITOR, POLYCARB .01UF 100V 1%		
C8		910500030	CAPACITOR, POLYCARB .01UF 100V 1%		
C9		910200045	CAPACITOR, TANTALUM 10UF 20V	2	
C10		910200022	CAPACITOR, DISK 0.1UF 25V		
C11		910200022	CAPACITOR, DISK 0.1UF 25V		
C12		910100002	CAPACITOR, DISK .005UF	1	
C13		910200003	CAPACITOR, ELECTROLYTIC N.P 5UF 30V	1	
C14		910200022	CAPACITOR, DISK 0.1UF 25V		
C15		910500033	CAPACITOR, POLYCARB .12UF 100V 1%	1	
C16		910200009	CAPACITOR, ELECTROLYTIC N.P 35UF 6V	2	
C17		910200047	CAPACITOR, TANTALUM 2.2UF 25V	1	
C18		910200046	CAPACITOR, TANTALUM 22UF 10V	2	
C19		910200046	CAPACITOR, TANTALUM 22UF 10V		
C20		910200022	CAPACITOR, DISK 0.1UF 25V		
C21		910200048	CAPACITOR, TANTALUM 3.9UF 15V 10%	1	
C22		910500020	CAPACITOR, MYLAR .068 50V 5%	1	
C23		910200045	CAPACITOR, TANTALUM 10UF 20V		
C24		910200009	CAPACITOR, ELECTROLYTIC N.P..35UF 6V		
C25		910200022	CAPACITOR, DISK 0.1UF 25V		
C26		910200022	CAPACITOR, DISK 0.1UF 25V		
C27		910500004	CAPACITOR, MYLAR .27UF 100V 5%	4	
C28		910500004	CAPACITOR, MYLAR .27UF 100V 5%		
C29		910200022	CAPACITOR, DISK 0.1UF 25V		
C30		910500017	CAPACITOR, MYLAR .033UF 100V 5%	2	
C31		910500003	CAPACITOR, MYLAR .15UF 100V 5%	3	
C32		910500003	CAPACITOR, MYLAR .15UF 100V 5%		
C33		910200022	CAPACITOR, DISK 0.1UF 25V		
C34		910200022	CAPACITOR, DISK 0.1UF 25V		
C35		910200022	CAPACITOR, DISK 0.1UF 25V		
C36		910200022	CAPACITOR, DISK 0.1UF 25V		
C37		910500004	CAPACITOR, MYLAR .27UF 100V 5%		
C38		910500004	CAPACITOR, MYLAR .27UF 100V 5%		

Table 8-2. (Continued)

ASSEMBLY NAME PHASE JITTER BOARD #2
ASSEMBLY NUMBER D-P1200-015-01

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
C39		910200022	CAPACITOR, DISK 0.1UF 25V		
C40		910200022	CAPACITOR, DISK 0.1UF 25V		
C41		910500017	CAPACITOR, MYLAR .033UF 100V 5%		
C42		910500003	CAPACITOR, MYLAR .15UF 100V 5%		
C43		910500013	CAPACITOR, MYLAR .001UF 100V 5%	1	
C44		910100012	CAPACITOR, DISK 10PF 1KV	1	
C45		910200022	CAPACITOR, DISK 0.1UF 25V		
C46		910200022	CAPACITOR, DISK 0.1UF 25V		
C47		910200063	CAPACITOR, TANTALEX 68UF 6V	1	
C48		910100005	CAPACITOR, DISK, 0.1UF 10V	7	
C49		910100005	CAPACITOR, DISK, 0.1UF 10V		
C50		910100005	CAPACITOR, DISK, 0.1UF 10V		
C51		910100005	CAPACITOR, DISK, 0.1UF 10V		
C52		910100005	CAPACITOR, DISK, 0.1UF 10V		
C53		910100005	CAPACITOR, DISK, 0.1UF 10V		
C54		910100005	CAPACITOR, DISK, 0.1UF 10V		
CR1		940200017	DIODE, ZENER 1N4736	2	
CR2		940200017	DIODE, ZENER 1N4736		
CR3		940200019	DIODE, ZENER 1N5237	1	
CR4		940200002	DIODE, ZENER 1N825	1	
CR5		940200005	DIODE, ZENER 1N5231A	1	
IC1		952000007	I.C. OP AMP NATIONAL LM311	1	
IC2		952000013	I.C. PHASE LOCK LOOP SIGNETIC NE567V	1	
IC3		952000020	I.C. OP AMP MI1458	1	
IC4		952000011	I.C. OP AMP SN72741P	6	
IC5		952000012	I.C. OP AMP SN748C	1	
IC6		950200020	I.C. DUAL SCHMITT TRIGGER SN7413N	2	
IC7		950200018	I.C. HEX INVERTER SN7416P	5	

Table 8-2. (Continued)

ASSEMBLY NAME PHASE JITTER BOARD #2
ASSEMBLY NUMBER D-P1200-015-01

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
IC8		950200020	I.C. DUAL SCHMITT TRIGGER SN7413N		
IC9		950200018	I.C. HEX INVERTER SN7416P		
IC10		950200002	I.C. QUAD NAND GATE SN7400	2	
IC11		950200023	I.C. QUAD NAND GATE SN7403	1	
IC12		950200018	I.C. HEX INVERTER SN7416P		
IC13		950200018	I.C. HEX INVERTER SN7416P		
IC14		952000011	I.C. OP AMP SN72741P		
IC15		950200018	I.C. HEX INVERTER SN7416P		
IC16		950200002	I.C. QUAD NAND GATE SN7400		
IC17		952000011	I.C. OP AMP SN72741P		
IC18		952000011	I.C. OP AMP SN72741P		
IC19		952000011	I.C. OP AMP SN72741P		
IC20		952000011	I.C. OP AMP SN72741P		
IC21		950200019	I.C. MONOSTABLE MULTIVIBRATOR SN74121N	2	
IC22		950200019	I.C. MONOSTABLE MULTIVIBRATOR SN74121N		
L1		970700006	INDUCTOR 100 MH 10%	1	
Q1		960100018	TRANSISTOR, NPN MPS-A12 (MOTOROLA)	3	
Q2		960100018	TRANSISTOR, NPN MPS-A12 (MOTOROLA)		
Q3		960100006	TRANSISTOR, PNP 2N5139	2	
Q4		962000005	TRANSISTOR, NPN 2N5134	7	
Q5		962000005	TRANSISTOR, NPN 2N5134		
Q6		960100008	TRANSISTOR, PNP 2N4062	7	
Q7		960100002	TRANSISTOR, NPN 2N3711	6	
Q8		960100002	TRANSISTOR, NPN 2N3711		
Q9		960100008	TRANSISTOR, PNP 2N4062		
Q10		960100008	TRANSISTOR, PNP 2N4062		

Table 8-2. (Continued)

ASSEMBLY NAME PHASE JITTER BOARD #2.
ASSEMBLY NUMBER D-P1200-015-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
Q11		962000005	TRANSISTOR, NPN 2N5134		
Q12		962000005	TRANSISTOR, NPN 2N5134		
Q13		960100006	TRANSISTOR, PNP 2N5139		
Q14		962000005	TRANSISTOR, NPN 2N5134		
Q15		962000005	TRANSISTOR, NPN 2N5134		
Q16		960100008	TRANSISTOR, PNP 2N4062		
Q17		960100002	TRANSISTOR, NPN 2N3711		
Q18		960100002	TRANSISTOR, NPN 2N3711		
Q19		960100008	TRANSISTOR, PNP 2N4062		
Q20		960100005	TRANSISTOR, NPN 2N5133	1	
Q21		960100008	TRANSISTOR, PNP 2N4062		
Q22		960100002	TRANSISTOR, NPN 2N3711		
Q23		960100002	TRANSISTOR, NPN 2N3711		
Q24		960100008	TRANSISTOR, PNP 2N4062		
Q25		962000005	TRANSISTOR, NPN 2N5134		
Q26		960100018	TRANSISTOR, NPN MPS-A12 (MOTOROLA)		
Q27		960100019	TRANSISTOR, PNP MPS-A65 (MOTOROLA)	1	
R1		930504020	RESISTOR, METAL 402 OHMS 1/8W 1%	1	
R2		930502000	RESISTOR, METAL 200 OHMS 1/8W 1%	1	
R3		930505621	RESISTOR, METAL 5.62K 1/8W 1%	3	
R4		930509531	RESISTOR, METAL 9.53K 1/8W 1%	1	
R5		920200103	RESISTOR, VARIABLE (MULTI-TURN) 10K	5	
R6		930504992	RESISTOR, METAL 49.9K 1/8W 1%	1	
R7		930508252	RESISTOR, METAL 82.5K 1/8W 1%	1	
R8		930505762	RESISTOR, METAL 57.6K 1/8W 1%	1	
R9		930503092	RESISTOR, METAL 30.9K 1/8W 1%	1	
R10		930506192	RESISTOR, METAL 61.9K 1/8W 1%	1	
R11		930505231	RESISTOR, METAL 5.23K 1/8W 1%	1	
R12		930501101	RESISTOR, METAL 1.10K 1/8W 1%	1	
R13		930700473	RESISTOR, CARBON 47K 1/4W 5%	2	
R14		930700332	RESISTOR, CARBON 3.3K 1/4W 5%	8	
R15		930700332	RESISTOR, CARBON 3.3K 1/4W 5%		
R16		930501001	RESISTOR, METAL 1K 1/8W 1%	1	
R17		930502873	RESISTOR, METAL 287K 1/8W 1%	1	
R18		930502371	RESISTOR, METAL 2.37K 1/8W 1%	1	
R19		930504320	RESISTOR, METAL 432 OHMS 1/8W 1%	1	

Table 8-2. (Continued)

ASSEMBLY NAME PHASE JITTER BOARD #2.
ASSEMBLY NUMBER D-P1200-015-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
R20		930700473	RESISTOR, CARBON 47K 1/4W 5%		
R21		930700391	RESISTOR, CARBON 390 OHMS 1/4W 5%	2	
R22		930700104	RESISTOR, CARBON 100K 1/4W 5%	1	
R23		930700271	RESISTOR, CARBON 270 OHMS 1/4W 5%	1	
R24		930700391	RESISTOR, CARBON 390 OHMS 1/4W 5%		
R25		930502492	RESISTOR, METAL, 24.9K 1/8W 1%	1	
R26		930900181	RESISTOR, CARBON, 180 OHMS 1W 5%	1	
R27		930700683	RESISTOR, CARBON, 68K 1/4W 5%	1	
R28		930700562	RESISTOR, CARBON, 5.6K 1/4W 5%	7	
R29		930700471	RESISTOR, CARBON, 470 OHMS 1/4W 5%	1	
R30		930700562	RESISTOR, CARBON, 5.6K 1/4W 5%		
R31		930700272	RESISTOR, CARBON 2.7K 1/4W 5%	3	
R32		930700272	RESISTOR, CARBON, 2.7K 1/4W 5%		
R33		930700123	RESISTOR, CARBON, 12K 1/4W 5%	1	
R34		930700272	RESISTOR, CARBON, 2.7K 1/4W 5%		
R35		930700102	RESISTOR, CARBON 1K 1/4W 5%	9	
R36		920200103	RESISTOR, VARIABLE (MULTI-TURN) 10K		
R37		930700102	RESISTOR, CARBON 1K 1/4W 5%		
R38		920200104	RESISTOR, VARIABLE (MULTI-TURN) 100K	1	
R39		930700332	RESISTOR, CARBON 3.3K 1/4W 5%		
R40		930504993	RESISTOR, METAL 499K 1/8W 1%	4	
R41		930504993	RESISTOR, METAL 499K 1/8W 1%		
R42		930700332	RESISTOR, CARBON 3.3K 1/4W 5%		
R43		930700562	RESISTOR, CARBON 5.6K 1/4W 5%		
R44		930505761	RESISTOR, METAL 5.76K 1/8W 1%	4	
R45		930505761	RESISTOR, METAL 5.76K 1/8W 1%		
R46		930501693	RESISTOR, METAL 169K 1/8W 1%	1	
R47		930700562	RESISTOR, CARBON 5.6K 1/4W 5%		
R48		930505621	RESISTOR, METAL 5.62K 1/8W 1%		
R49		930700102	RESISTOR, CARBON 1K 1/4W 5%		
R50		930700102	RESISTOR, CARBON 1K 1/4W 5%		
R51		920200504	RESISTOR, VARIABLE (MULTI-TURN) 500K	1	
R52		930700102	RESISTOR, CARBON 1K 1/4W 5%		
R53		930700332	RESISTOR, CARBON 3.3K 1/4W 5%		
R54		930700332	RESISTOR, CARBON 3.3K 1/4W 5%		
R55		930504991	RESISTOR, METAL 4.99K 1/8W 1%	2	
R56		930504991	RESISTOR, METAL 4.99K 1/8W 1%		
R57		930501004	RESISTOR, METAL 1.0M 1/8W 1%	2	

Table 8-2. (Continued)

ASSEMBLY NAME PHASE JITTER BOARD #2
ASSEMBLY NUMBER D-P1200-015-01

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
R58		930501004	RESISTOR, METAL 1.0M 1/8W 1%		
R59		930700102	RESISTOR, CARBON 1K 1/4W 5%		
R60		930501181	RESISTOR, METAL 1.18K 1/8W 1%	1	
R61		930506191	RESISTOR, METAL 6.19K 1/8W 1%	1	
R62		930503741	RESISTOR, METAL 3.74K 1/8W 1%	1	
R63		930700102	RESISTOR, CARBON 1K 1/4W 5%		
R64		930700102	RESISTOR, CARBON 1K 1/4W 5%		
R65		930700102	RESISTOR, CARBON 1K 1/4W 5%		
R66		930700332	RESISTOR, CARBON 3.3K 1/4W 5%		
R67		930700332	RESISTOR, CARBON 3.3K 1/4W 5%		
R68		930504993	RESISTOR, METAL 499K 1/8W 1%		
R69		920200103	RESISTOR, VARIABLE (MULTI-TURN) 10K		
R70		930505761	RESISTOR, METAL 5.76K 1/8W 1%		
R71		930700562	RESISTOR, CARBON 5.6K 1/4W 5%		
R72		930505761	RESISTOR, METAL 5.76K 1/8W 1%		
R73		930700562	RESISTOR, CARBON 5.6K 1/4W 1%		
R74		920200103	RESISTOR, VARIABLE (MULTI-TURN) 10K		
R75		920200103	RESISTOR, VARIABLE (MULTI-TURN) 10K		
R76		930505621	RESISTOR, METAL 5.62K 1/8W 1%		
R77		930502872	RESISTOR, METAL 28.7K 1/8W 1%	1	
R78		930700562	RESISTOR, CARBON 5.6K 1/4W 5%		
R79		930502151	RESISTOR, METAL 2.15K 1/8W 1%	2	
R80		930502151	RESISTOR, METAL 2.15K 1/8W 1%		
R81		930700222	RESISTOR, CARBON 2.2K 1/4W 5%	1	
R82		930504530	RESISTOR, METAL 453 OHMS 1/8W 1%	1	
R83		930502801	RESISTOR, METAL 2.8K 1/8W 1%	1	
R84		930502743	RESISTOR, METAL 274K 1/8W 1%	2	
R85		930502743	RESISTOR, METAL 274K 1/8W 1%		
R86		930506982	RESISTOR, METAL 69.8K 1/8W 1%	1	
R87		930506652	RESISTOR, METAL 66.5K 1/8W 1%	1	
R88		930501473	RESISTOR, METAL 147K 1/8W 1%	1	
R89		930504993	RESISTOR, METAL 499K 1/8W 1%		
S1		971600003	SWITCH, 2 PDT	2	
S2		971600003	SWITCH, 2 PDT		
T1		971900006	TRANSFORMER (#3168)	1	

Table 8-2. (Continued)

ASSEMBLY NAME PHASE JITTER BOARD #2.
ASSEMBLY NUMBER D-P1200-015-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
	1	D-P1200-014-01	PRINTED CIRCUIT BOARD, REV D	1	
	2	971400001	SOCKET, INT. CKT 14 PIN DIP	12	
	3	971400002	SOCKET, INT. CKT 16 PIN DIP	1	
	4	971400006	SOCKET, INT. CKT 8 PIN ROUND	2	
	5	971400007	SOCKET, INT. CKT 8 PIN DIP	8	
	6	971700002	TERMINAL, 1457-2-01	17	
	7	971100001	PAD, TRANSISTOR TO18-11	10	
	8	AWG 22	WIRE, STRANDED	AR	

ISSUE D CHANGE ORDER 169

LEGEND:

AR = As Required
C = Capacitor
CR = Diode
F = Fuse
IC = Integrated Circuit
L = Inductor (Choke)
NX = Display Tube
Q = Transistor
R = Resistor
S = Switch
T = Transformer
Y = Cyrstal

Table 8-3. Power Supply Parts List

ASSEMBLY NAME ASSEMBLY P.C. BOARD #3.
ASSEMBLY NUMBER P1100-034-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
--		P1100-035-01	PRINTED CIRCUIT BOARD	1	
C1		910200059	CAPACITOR 500uf 50V	2	
C2		910200059	CAPACITOR 500uf 50V		
C3		910200021	CAPACITOR 5000uf 10V	1	
C4		910200006	CAPACITOR 10uf 250V	1	
C5		910700003	CAPACITOR .047uf 250V	2	
C6		910700003	CAPACITOR .047uf 250V		
C7			NOT USED		
C8		910200014	CAPACITOR 150uf 16V	1	
C9		910200016	CAPACITOR 200uf 6V	1	
CR1		940200008	DIODE MDA940A-2	2	
CR2		940200001	DIODE IN662	2	
CR3		940200001	DIODE IN662		
CR4		940200008	DIODE MDA940A-2		
CR5		940200018	DIODE IN4001	2	
CR6		940200009	DIODE MDA940A-6	1	
CR7		940200018	DIODE IN4001		
R1		930700153	RESISTOR 15K 1/4W 5%	1	
R2		930700562	RESISTOR 5.6K 1/4W 5%	3	
R3		930504421	RESISTOR 4.42K 1/8W 1%	2	
R4		930505621	RESISTOR 5.62K 1/8W 1%	2	
R5		930700273	RESISTOR 27K 1/4W 5%	2	
R6		930700562	RESISTOR 5.6K 1/4W 5%		
R7		930700913	RESISTOR 91K 1/4W 5%	1	
R8		930504421	RESISTOR 4.42K 1/8W 1%		
R9		930505621	RESISTOR 5.62K 1/8W 1%		
R10		930700273	RESISTOR 27K 1/4W 5%		
R11		930700562	RESISTOR 5.6K 1/4W 5%		
R12		930700333	RESISTOR 33K 1/4W 5%	2	
R13		930503651	RESISTOR 3.65K 1/8W 1%	1	

Table 8-3. (Continued)

ASSEMBLY NAME ASSEMBLY P.C. BOARD #3
ASSEMBLY NUMBER P1100-034-01

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
R14		930501212	RESISTOR 12.1K 1/8W 1%	1	
R15		930700333	RESISTOR 33K 1/4W 5%		
R16		930700184	RESISTOR 180K 1/4W 5%	1	
R17		920200202	RESISTOR (POT) 2K	2	
R18		920200202	RESISTOR (POT) 2K		
Q1		962000008	TRANSISTOR 2N5138	1	
Q2		962000006	TRANSISTOR 2N5137	3	
Q3			SEE ASSEMBLY PARTS LIST		
Q4		962000002	TRANSISTOR 2N3565	6	
Q5		962000002	TRANSISTOR 2N3565		
Q6		960100006	TRANSISTOR 2N5139	2	
Q7		962000006	TRANSISTOR 2N5135		
Q8			SEE ASSEMBLY PARTS LIST		
Q9		962000002	TRANSISTOR 2N3565		
Q10		962000002	TRANSISTOR 2N3565		
Q11		960100006	TRANSISTOR 2N5139		
Q12		962000006	TRANSISTOR 2N5135		
Q13			SEE ASSEMBLY PARTS LIST		
Q14		962000002	TRANSISTOR 2N3565		
Q15		962000002	TRANSISTOR 2N3565		
	1	970400010	CONNECTOR 30 PIN	2	
	2	971100001	SOCKET (TO 18-11)	8	
	3	971100003	PAD (A-1159)	3	
	4	971400001	IC SOCKET (14 PIN)	1	
	5	971700002	TERMINAL (1457-2-01)	9	

ISSUE B CHANGE ORDER 114

Table 8-3. (Continued)

ASSEMBLY NAME ASSEMBLY, POWER SUPPLY.
ASSEMBLY NUMBER P1100-022-02.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
F1		972100007	FUSE, SLO-BLO 1/2 AMP (115 Vac)	1	
F1		972100006	FUSE, SLO-BLO 1/4 AMP (230 Vac)	1	
Q3		961000009	TRANSISTOR, MJE3055	3	
Q8		961000009	TRANSISTOR, MJE3055	3	
Q13		961000009	TRANSISTOR, MJE3055	3	
S1a		971600015	SWITCH, SLIDE (115 Vac/230 Vac)	1	
T1		971900005	TRANSFORMER, POWER	1	
		970300004	CORD, POWER		

ISSUE B CHANGE ORDER 217

LEGEND:

AR = As Required
C = Capacitor
CR = Diode
F = Fuse
IC = Integrated Circuit
L = Inductor (Choke)
NX = Display Tube
Q = Transistor
R = Resistor
S = Switch
T = Transformer
Y = Cyrstal

Table 8-4. Chassis Assembly Parts List

ASSEMBLY NAME ASSEMBLY, CHASSIS.
ASSEMBLY NUMBER 1200-025-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
		972000001	JACK (INPUT AND OUTPUT)	2	
		940300003	LIGHT EMITTING DIODE (LED), POWER	1	
		940300003	LIGHT EMITTING DIODE (LED), INPUT MON.	1	
			SWITCH ASSEMBLY (P-P FLT IN, OUT, PEAK/CYCLE)		
		970800002	KNOB	1	
S1		971600033	SWITCH, WAFER	1	
		P1200-002-02	WINDOW (RED)	1	
		P1200-010-01	CABLE, RIBBON (CKT BOARD #1 to CKT BD #2)	1	
		P1200-013-01	CIRCUIT BOARD #1	1	
		P1200-015-01	CIRCUIT BOARD #2	1	

ISSUE C CHANGE ORDER 181, 184

Table 8-5. Handle and Frame Assembly Parts List

ASSEMBLY NAME ASSEMBLY, HANDLE & FRAME.
ASSEMBLY NUMBER P1100-009-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
			HANDLE ASSEMBLY		
		C-P1100-053-01	HANDLE (BLACK)	1	
		D-P1100-006-01	HANDLE SUPPORTS (GREEN)	2	
		10-32 x 1/2	SCREW, FLAT HEAD (HANDLE TO HANDLE SUPPORT)	2	
			SCREW ASSEMBLY (HANDLE SUPPORT TO FRAME)		
		6-32 x 3/8	SCREW, BINDER HEAD S.S.	2	
		6 x 3/8 O.D.	FLAT WASHER	2	
		C-P1100-047-01	SPRING (FLAT)	2	
			RUBBER FEET ASSEMBLY, BOTTOM		
		972500019	RUBBER FOOT (BUMPER), BOTTOM	4	
		10-32 x 1/2	SCREW, BINDER HEAD S.S.	4	
		10-32	NUT, KEEPER	4	
			BEZEL ASSEMBLY, FRONT		
		P1100-005-01	BEZEL, FRONT	1	
		10-32 x 1¼	SCREW, BINDER HEAD S.S. (BEZEL TO CHASSIS)	4	

ISSUE B CHANGE ORDER 217

Table 8-6. 1200-L1 (Rear Bezel) Assembly Parts List

ASSEMBLY NAME ASSEMBLY, 1200-L1.
ASSEMBLY NUMBER P1200-007-01.

PARTS LIST

REF DES	ITEM NO.	STOCK NO.	DESCRIPTION	TOTAL QTY	NOTES
			BEZEL ASSEMBLY, REAR		
		P1100-043-01	BEZEL REAR	1	
		10 x 32 x 3/8	SCREW, BINDER HEAD S.S. (BEZEL TO CHASSIS)	2	
		972500050	RUBBER FEET, REAR	4	
		6-32 x 1/2	SCREW, BINDER HEAD S.S. (RUBBER FEET TO	4	
			REAR BEZEL)		

ISSUE B CHANGE ORDER 181, 184

ELECTRONIC SYMBOLS & NOTES

1 COMPONENT VALUES ARE ASSUMED TO BE THE FOLLOWING, UNLESS OTHERWISE SPECIFIED
RESISTANCE IN OHMS
CAPACITANCE IN MICROFARADS
INDUCTANCE IN MILLIHENRYS

REFERENCE PARTS LISTS FOR EXACT SPECIFICATIONS

2 (1) (OR) (2) = OUTPUT PIN (PIN NUMBER ENCLOSED).

3 (1) (OR) (2) = INPUT PIN (PIN NUMBER ENCLOSED)

4 H = HIGH, LOGIC "1", +5 Vdc.

5 L = LOW, LOGIC "0", 0 Vdc.

6 = DENOTES CHASSIS MOUNTED OR CONNECTOR

7 = DENOTES FUNCTIONAL CIRCUIT OR LOGIC

8 = DENOTES DIFFERENT CIRCUIT BOARD

9 = ADJUSTABLE RESISTOR.

10 = ADJUSTABLE CAPACITOR.

11 = ADJUSTABLE INDUCTOR.

12 Y, Y = TEST POINT, SOLDER POINT

13 = LOGIC GROUND (GRD).

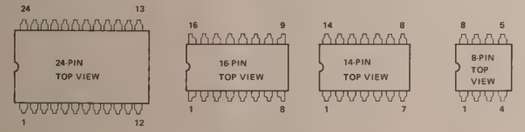
14 = RETURN (ISOLATED FROM ⏚ AND ⏚)

15 = EARTH GROUND

16 ALL RELAYS ARE SHOWN DE-ENERGIZED, UNLESS OTHERWISE SPECIFIED.

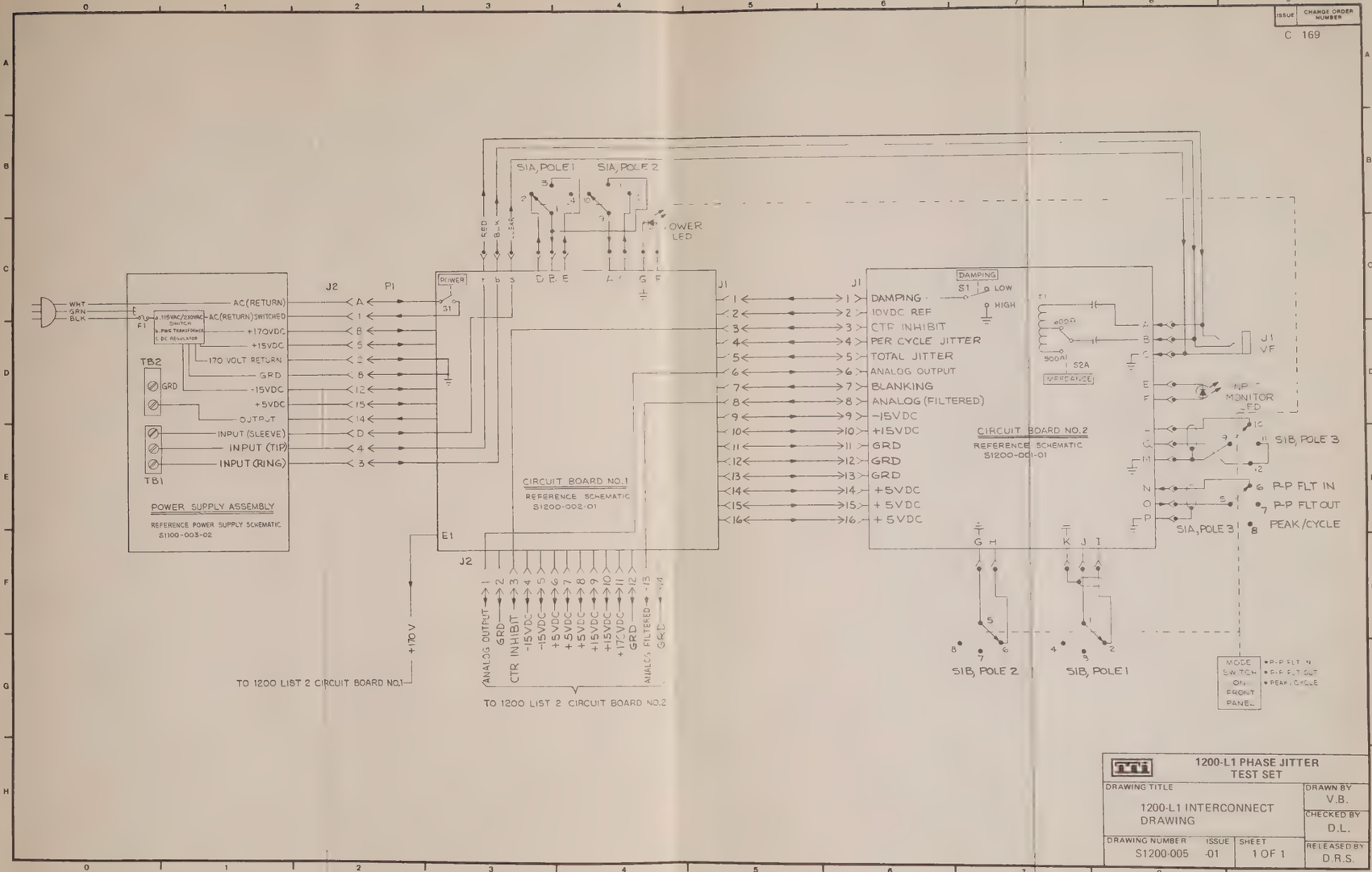
17 = FRONT AND/OR REAR PANEL CALLOUT.

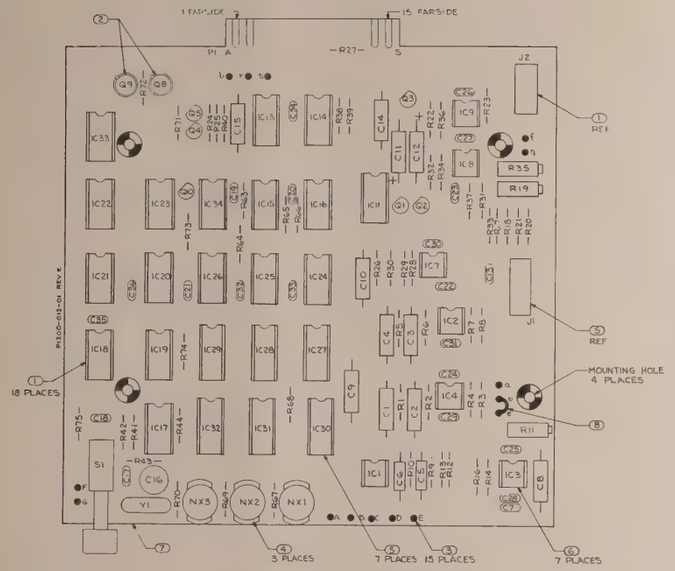
18 INTEGRATED CIRCUITS = DUAL IN-LINE AND METAL CASE (CAN) TYPES:



DUAL IN-LINE TYPE

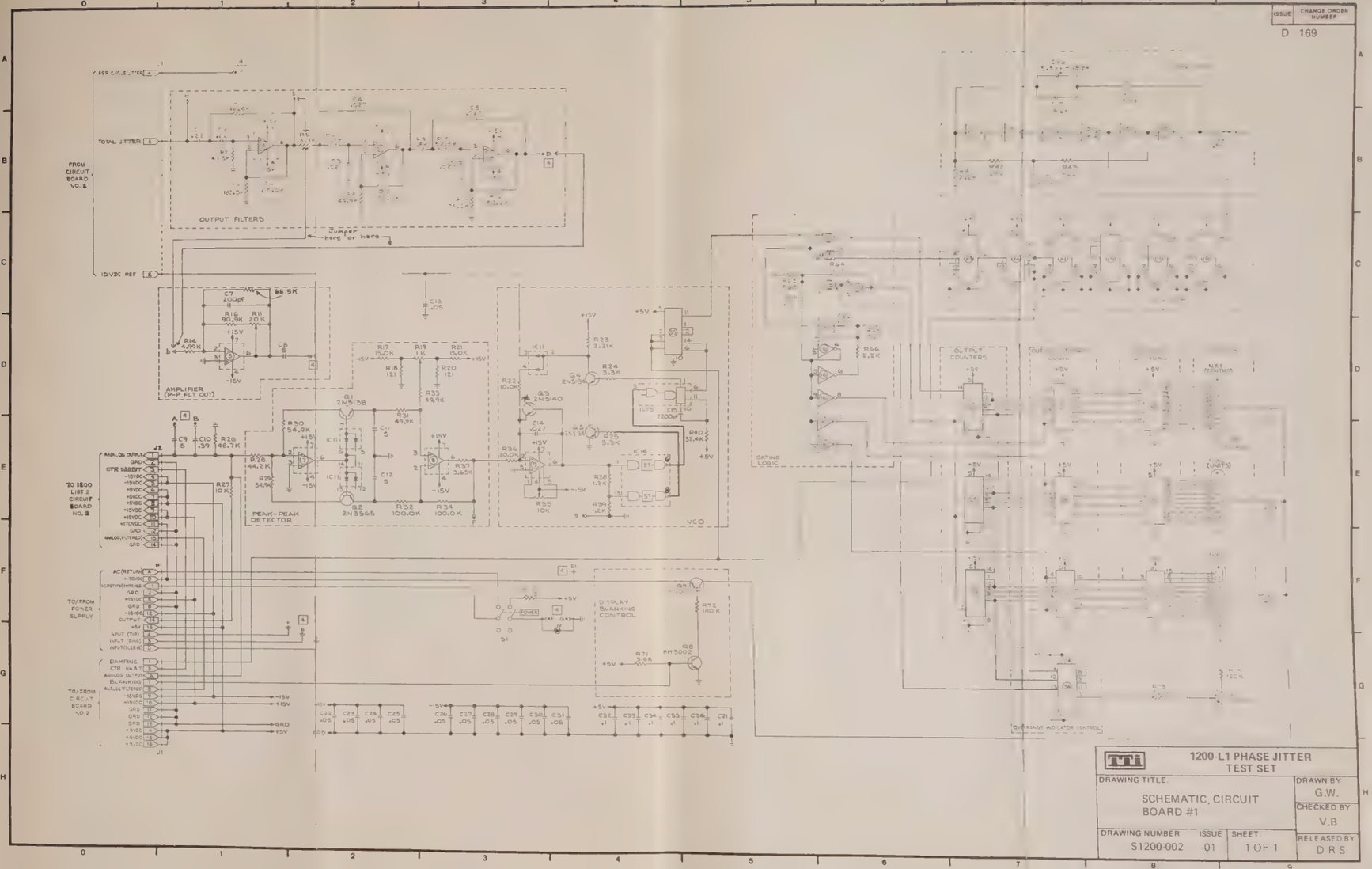
METAL CASE TYPE

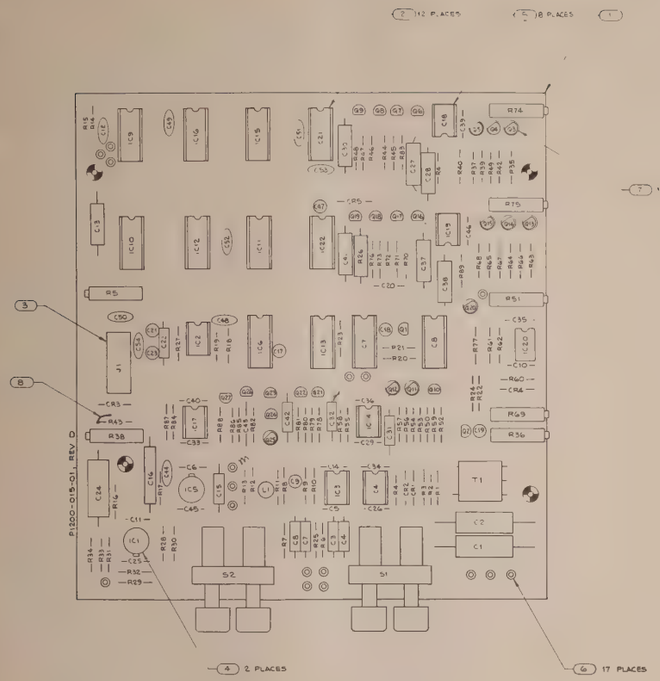




NOTES ( ) = SEE ENCLOSED ITEM NO. ON PARTS LIST

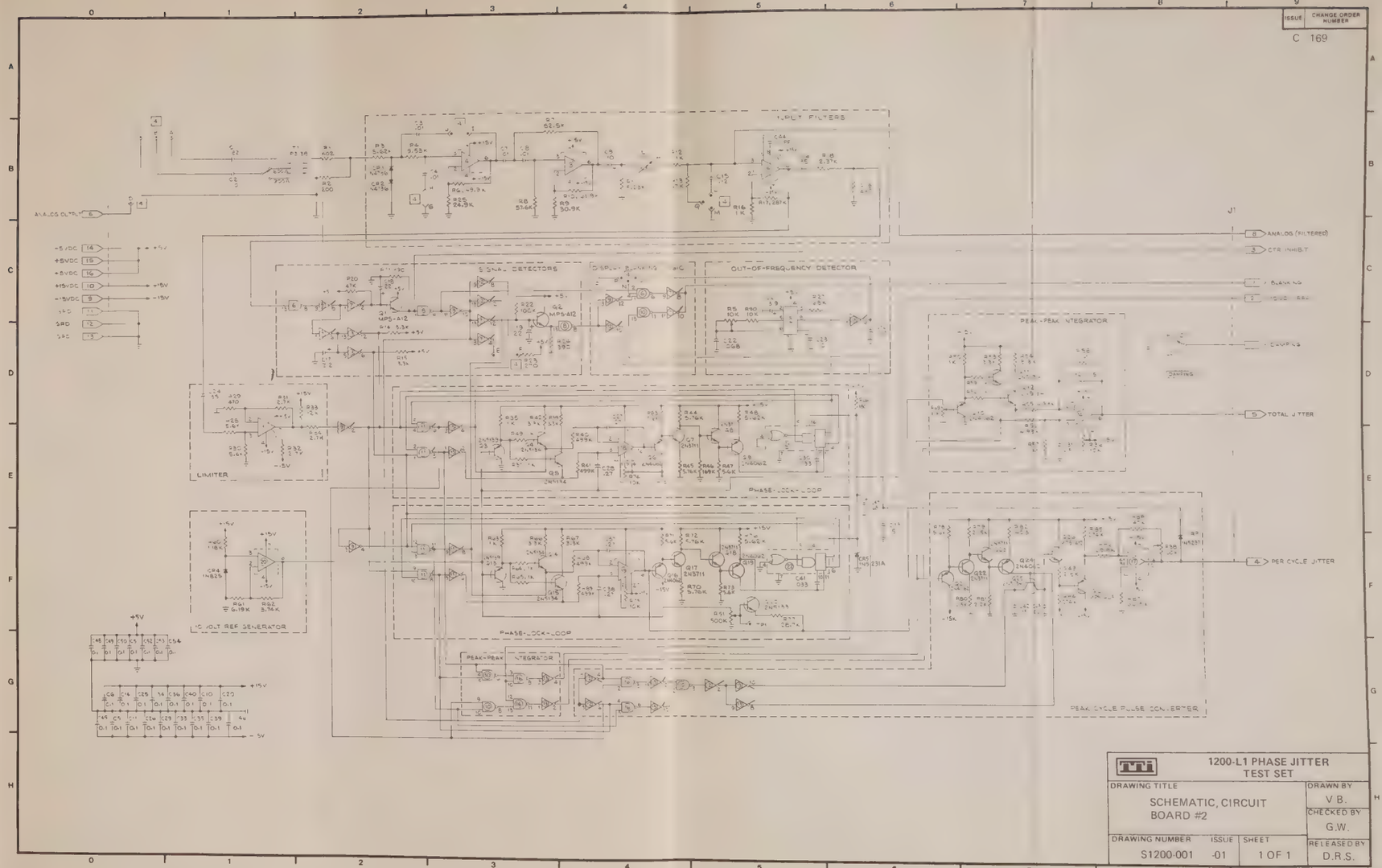
PARTS LOCATING DIAGRAM,
Circuit Board 1

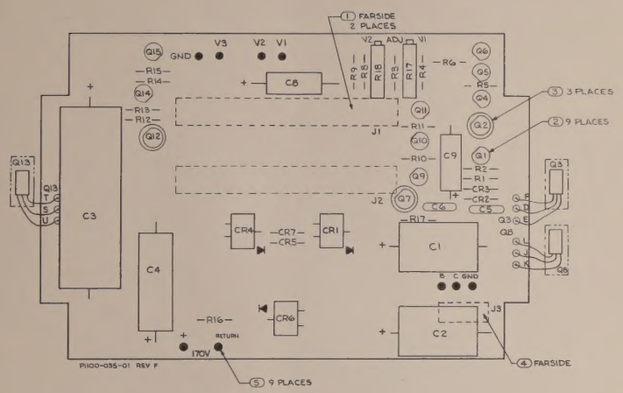




NOTES ( ) = SEE ENCLOSED ITEM NO. ON PARTS LIST

PARTS LOCATING DIAGRAM,
Circuit Board 2





NOTES: ⬭ = SEE ENCLOSED ITEM NO. ON PARTS LIST

PARTS LOCATING DIAGRAM,
Circuit Board 3

ISSUE	CHANGE ORDER NUMBER
	C 230

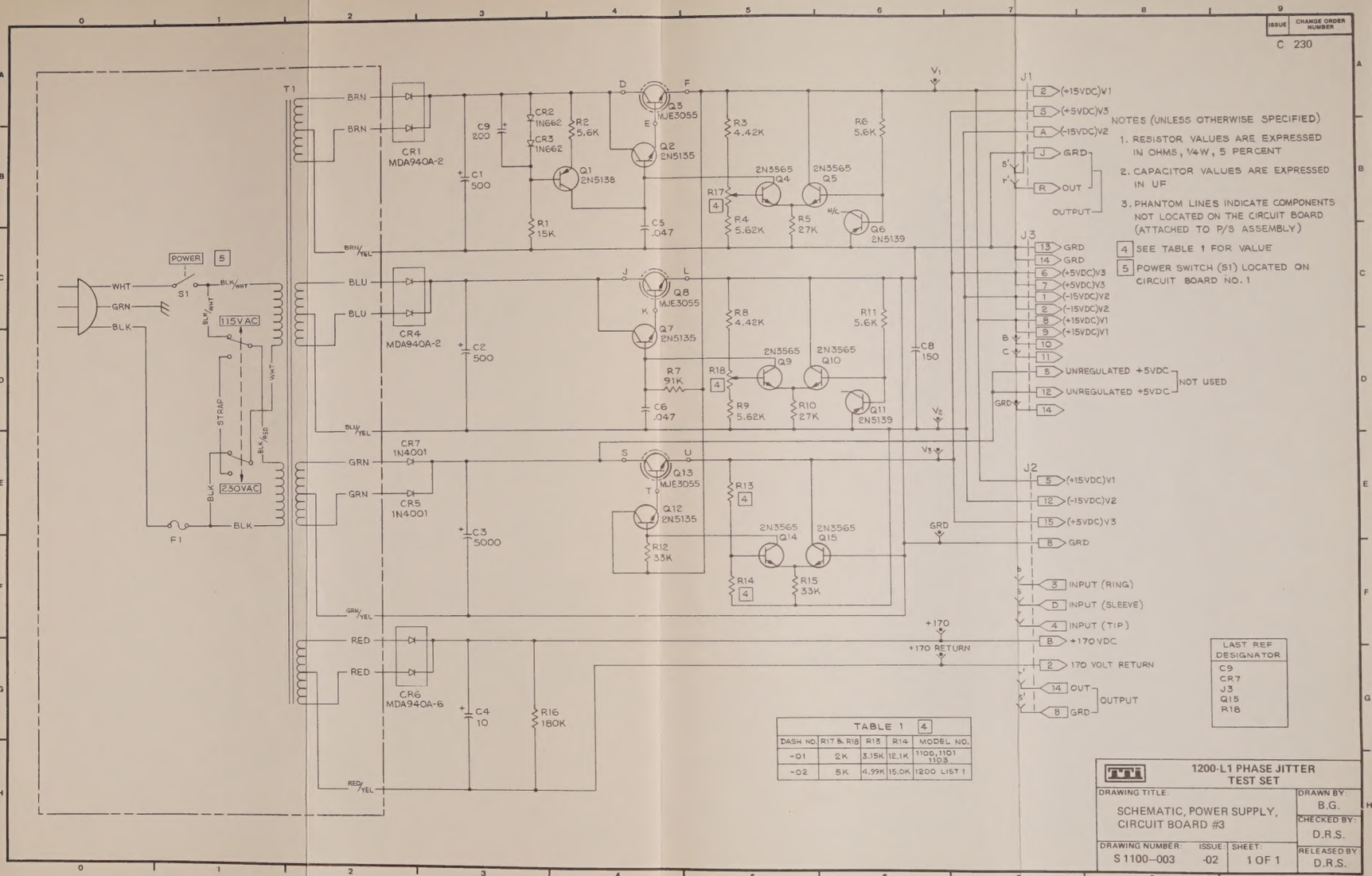


TABLE 1 [4]				
DASH NO.	R17 & R18	R13	R14	MODEL NO.
-01	2K	3.15K	12.1K	1100, 1101 1103
-02	5K	4.99K	15.0K	1200 LIST 1

LAST REF DESIGNATOR
C9
CR7
J3
Q15
R18

TTi	1200-L1 PHASE JITTER TEST SET		
DRAWING TITLE: SCHEMATIC, POWER SUPPLY, CIRCUIT BOARD #3			DRAWN BY: B.G.
			CHECKED BY: D.R.S.
DRAWING NUMBER: S 1100–003	ISSUE: -02	SHEET: 1 OF 1	RELEASED BY: D.R.S.

WARRANTY

TTI warrants instruments manufactured by it to be free from defects in material and workmanship under normal use and service within specified ratings and operating conditions. Our obligation under this Warranty is limited to the repair or replacement, at TTI's sole discretion, of any instrument or part thereof which, when returned to TTI within one year of original shipment and upon our examination proves to be thus defective. This warranty includes the cost of return surface transportation from the factory. It does not include the cost of transportation to the factory and/or the cost of packaging the instrument for return to the factory, unless such instrument is returned within 30 days from the date of original shipment and prior written authorization for the reimbursement of such cost is obtained from the factory.

This Warranty shall not apply to any instrument which has been (1) repaired, worked on, or altered by persons not authorized by TTI so as, in TTI's sole judgement, to injure the stability, reliability, or proper operation of such instrument; (2) subjected to misuse, negligence, or accident; and (3) connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by TTI. Accessories, including, but not limited to fuses and batteries, not of TTI's manufacture, used or installed with this instrument are not covered by this Warranty.

TTI reserves the right to make changes in the design or construction of its instruments at any time without incurring any obligation to make these changes in instruments previously sold and delivered.

The repair or replacement of any part or parts of an instrument under this agreement does not void or extend the original Warranty period for the whole instrument. Repaired or replaced parts are warranted for the remainder of the instrument warranty period or for 90 days from the date of repair, whichever shall be longer.

We are not liable for consequential or incidental damages. This Warranty is in lieu of all others expressed or implied and no representative or person is authorized to assume for us any other obligations or liabilities in connection with the sale of TTI instruments and products.

Instrument serial number _____

TTI shipping date _____